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ABSTRACT

This curriculum guide provides a model for organizing vocational instructional content from which secondary level instructors can extract an electronics cluster curriculum that meets local program needs. Primarily oriented towards classroom use, the guide may also assist administrators, counselors, and lay people involved in local school systems. Following a discussion of the philosophy, purpose, and objectives underlying state and local vocational education programs in Georgia, occupational and program information is provided, including a description of the field of electronics, electronics cluster program objectives, program exit points, tasks typically performed in the field, and performance standards for graduation. Presented next are a series of unit guides, each of which contains the following: a task statement, a performance objective, instructional activities, suggested instructional materials, and evaluation criteria. The next two sections consist of a sample course outline and curriculum structure and various student record forms. Facility layouts are described for group and individualized instructional activities. Appended to the guide are listings of resources and resource addresses, suggestions for working with special needs students, and a definition of terms. (MN)

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ELECTRONICS CLUSTER

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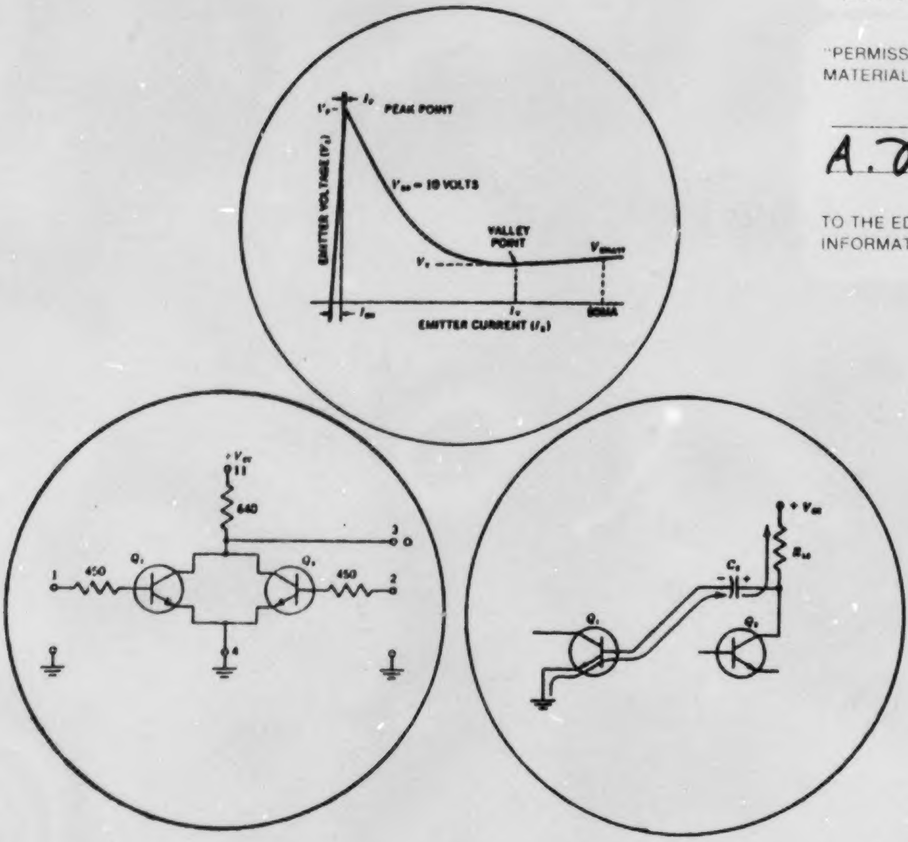
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CURRICULUM GUIDE

Georgia Department of Education

ELECTRONICS CLUSTER

Developed Under Contractual Agreement with

Division of Program Development
Office of Vocational Education
Georgia Department of Education
Atlanta, Georgia 30334
Charles McDaniel, State Superintendent of Schools
1981

ELECTRONICS CLUSTER

Developed By

The University of Georgia

Under the Direction of

Dr. Paul Scott

Vocational Education Materials Center

Division of Vocational Education

College of Education

Dr. George L. O'Kelley, Jr.

Division Chairman

4

ELECTRONICS CLUSTER

Charles C. Connor, Jr., Electronics/Radio-TV

Series Editor

DEVELOPERS

Pamela E. Smith	Technical Writer
Charles C. Connor	Technical Writer
Hoyt Sappe	Technical Writer

CONTRIBUTORS

C. Paul Scott	Writer, Special Needs
Raymond H. Butler	Writer, Special Needs
Rhonda Hefner Packer	Editor/Production

GRAPHICS

Calvin Pelfrey	Graphic Artist

TYPISTS

Teresa Whitehead	Project Secretary
Gerry DeWald	Typist
Janie Duceatt	Typist
Marchia Elder	Typist
Carolyn Graham	Typist
Janice Martin	Typist
Gay Weaver	Typist
Frankie Wright	Typist
Wanda Wright	Typist

Division of Vocational Education
College of Education
University of Georgia, Athens, Ga.

POLICIES AND PROCEDURES FOR THE CENTER

PURPOSE OF THE CENTER

The Vocational Education Materials Center functions within the division of Vocational Education, University of Georgia. This Center operates under grants from the U.S. Office of Education, and the Georgia State Department of Education with the support of the College of Education. The Center is comprehensive in its commitment and approach to the development and dissemination of materials in the broad field of Vocational Education.

The purpose of the Center is to increase the capability of Georgia's delivery system for Vocational Education. Specifically, the Center is committed to:

1. Develop materials to assist in the implementation of proposed curricula and to enhance the teaching Vocational Education.
2. Conduct and report curriculum research related to Vocational Education.
3. Provide a production and dissemination center to Vocational Education materials.
4. Provide direct experiences in curriculum development and diffusion for advanced graduate stduents.
5. Enable faculty members to participate in the development and implementation of a variety of curriculum materials.

Dr. G.L. O'Kelley, Jr.; Chairman
Division of Vocational Education
628 Aderhold Hall
University of Georgia
Athens, Georgia 30602

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PURPOSE AND UTILIZATION OF THE CURRICULUM GUIDES

The purpose of this curriculum guide is to provide a suggested model for organizing vocational instructional content. In many cases, more material is available than may be needed, there fore, an instructor will need to adapt the content to meet his/her program needs.

While the guide is primarily oriented towards the classroom, whether as a primary resource or as a supplement to other teaching materials; it may also assist administrators, counselors and lay people involved in local school systems. The following outline provides an overview of the various ways these groups may utilize the curriculum guides.

a) Vocational teachers.

1. Provide a guide for organizing their program of instruction,
2. Assist in establishing program objectives,
3. Serve as a curriculum materials resource guide,
4.. Improve communications with employers and advisory committees
5. Facilitate competency based instruction,
6. Facilitate either group or self-paced instruction,
7. Include content by quarter and semester,
8. Cross-reference with existing state developed instructional materials (PLACE packages and post secondary I.I.).

b) Vocational supervisors and administrators.

1. Assist in defining the scope and content of their programs,
2. Provide a means to improve curriculum management functions,
3. Serve as a guide for admissions and job placement functions,
4. Improve communications with employers and advisory committees.

c) Counseling and guidance staff.

1. Provide a data base for counseling and guidance personnel,
2. Identify student exit points (Career Options),
3. Serve as guide for admissions and job placement,

4. Correlate with new State Board of Education graduation requirements,
5. Provide specific content sequencing by quarter and semester for student scheduling,
6. Provide (a) curriculum options for the disadvantaged handicapped student, (b) curriculum modifications for SPECIAL NEEDS students, (c) typical admission requirements for regular and SPECIAL NEEDS students.

(d) Local Curriculum Coordination Committees.

1. Serve as a guide in working out articulation arrangements,
2. Improve definitions of the relationship between secondary clusters and post secondary specialized programs.

Vocational teachers, supervisors and administrators, counseling and guidance staff and local curriculum coordination committees will be primary users of this guide, however, the use of the guide is not limited to these groups, but by any and all groups directly related in designing a vocational curriculum.

-Foreword-

It has been the privilege of the Division of Vocational Education, University of Georgia, to participate in the development of 48 curriculum guides for Georgia vocational education programs. This work was sponsored by the Division of Program Development, Office of Vocational Education, State Department of Education. The completion of these guides meets a long standing need to provide a comprehensive curriculum overview of the vocational education programs available in Georgia schools. This developmental activity involved one of the largest professional staffs ever assembled for such work. Numerous teachers, teacher educators and state staff members have either written parts of the guides or served on the field review teams. These professionals were supported by a myriad of technical people and a host of typists who literally worked from dawn to dusk to ensure that the guides were produced in a timely fashion.

Be assured that this guide is not intended to be your curriculum or the curriculum of any school. The purpose of this project staff, and I am sure of the state OVE staff, is to offer a guide with supporting resources and teaching ideas from which the vocational instructor can extract a curriculum that meets local needs. The guide, however, does simplify curriculum decisions concerning sequencing and the selection of resources and media support.

The Task Linkage Project and appropriate V'TECS catalogs were used as the beginning point for this guide and all of the others. To assure that these task listings were directly related to Georgia vocational education programs and industry, they were subjected to additional study and review by appropriate teachers.

At some point in the future, this guide will need to be revised. To ensure that such a revision truly reflects the needs of Georgia's vocational education programs, the developers need your reactions, comments and ideas. We will also be interested in how you use this guide. Let us hear from you.

Paul Scott
Curriculum Guide Projects I & II

SECTION I

PHILOSOPHY, PURPOSE & OBJECTIVES

SECTION I

Section I Content List

State Philosophy and Goals
Local Philosophy and Goals

Section I provides an overview of the philosophies, purposes and goals for vocational education in the State of Georgia. These are applied to vocational education at the secondary level, however, it is recognized that more specific philosophies, purposes and goals will be applicable depending on the character of the local program.

VOCATIONAL EDUCATION IN GEORGIA

A. PHILOSOPHY

The Georgia Board of Education perceives vocational education as a vital component in the education of the young and adult citizens of this State. Appropriate programs of vocational education and ancillary services should be made readily available to individuals in middle schools, vocational divisions of junior colleges, vocational centers, the Quick Start program and other adult programs designed to train or retrain workers for useful and satisfying employment.

Special services and assistance must be provided to those who need it in order to participate or benefit from vocational education. This includes women, minorities, the displaced homemaker and other displaced workers, those with limited English-speaking ability, the disadvantaged and the handicapped.

Since men and women spend the greater part of their lives at some form of work, the State should provide opportunities for all its citizens to develop the knowledge, skills and attitudes necessary for them to secure personally satisfying and socially useful employment.

B. PURPOSE

The purpose of vocational education shall be to improve the economic well-being of Georgia citizens by preparing individuals, through organized learning experiences, to select, obtain and advance in recognized occupations.

SECONDARY VOCATIONAL EDUCATION

A. PURPOSE

The purpose of secondary vocational education is to provide training opportunities to middle school students which are of sufficient variety and quality to enable them to make wise career choices, and at the high school level to become familiar with one or more occupations of interest and to specialize in a given occupation to the extent needed to acquire entry-level job skills and knowledge, or to enter more specialized training at the postsecondary level.

B. OBJECTIVES

1. At the middle school level, to provide exploratory PECE and Industrial Arts programs.

2. At the high school level, to provide:
   a. Exploratory and prevocational Industrial Arts programs.
   b. Prevocational programs in occupational clusters for entry into specialized programs in the 11th and 12th grades, or at the postsecondary level.
   c. Training in a single occupational skill of sufficient depth to gain entry-level employability, or the option to continue specialized training at the postsecondary level.
   d. Competency-based programs of occupational preparation which enable students advance as far as possible through a planned sequence of courses leading to an occupational objective of greatest interest to the student.
   e. Opportunities and activities for students to develop and improve affective skills needed for employment.
   f. Vocational guidance, counseling, remedial and supportive programs and services needed by students to select and complete a program of vocational education.
   g. Ancillary and supportive services necessary to ensure that all students have access to training opportunities regardless of race, sex, national origin, disadvantagement of handicap.
   h. Opportunities for students to obtain or improve Home Economics and Consumer Education skills.
   i. Vocational education programs such that 50% of those individuals who complete or leave a program of occupational preparation, and are available for employment, find employment in the field for which trained, or in a related field.

STATEMENT OF LOCAL SYSTEM PHILOSOPHY, PURPOSE AND OBJECTIVES FOR VOCATIONAL EDUCATION

(This page is intentionally left blank so that local systems may insert their copy of philosophy, purpose and goals for vocational education.)

SECTION II

PROGRAM DESCRIPTION & RELATED INFORMATION

SECTION II

Section II Content List

Employability Skills
Electronics Cluster Occupational Description
Electronics Cluster Program Objective
Definition of the D.O.T. Code
Description of Electronics Cluster D.O.T.
Task Listing by D.O.T. Code

The major goal of vocational education in Georgia is to prepare individuals, through organized learning experiences, to select, obtain and advance in recognized occupations. Section II provides an overview of employability skills that are desirable in any occupation and relates their significance to the specific occupational area of Electronics Cluster.

The Electronics Cluster Program Objective contains the specific occupational titles. These occupational titles are further explained in the description of the occupational exit points and task listing. The concentration of the program is based on these tasks.

EMPLOYABILITY SKILLS

Employability skills exert a great deal of influence on a person's ability to get and keep a job. Surveys indicate that more people lose their jobs because of poor attitudes toward their job than for lack of job skills. For this reason it is important that information concerning the following employability skills be provided as an ongoing part of the program.

1. Getting a job
   a. Filling out job applications
   b. Developing a resume
   c. Preparing for a job interview

2. Keeping a job
   a. Be on time and regular in attendance
   b. Maintain a fair share of the work-load
   c. Work without supervision
   d. Meet production schedules
   e. Properly care for and use equipment
   f. Dress appropriately for the job
   g. Maintain good personal hygiene
   h. Develop and maintain good communication with supervisors and co-workers

A recent study sponsored by the Illinois Department of Adult, Vocational and Technical Education and conducted by the University of Illinois, "Survival Skills: Mastering the Human Aspects of Work", has identified twelve topics that might be developed into instructional modules for teaching occupational survival skills. The author, Robert E. Nelson, outlines these topics listed below and on the next page, each followed by a general objective which indicates the relationship between the topic and the survival skills required to maintain a job.

*"1. Working in an Organization: To familiarize students with the reasons for the formation of organizations and the common characteristics of organizations.

2. Understanding Self and Others: To have students develop insights into causes of human behavior and learn to interpret their own behavior and the behavior of other.

3. Motivation for Work: To have students develop and understanding of motivations into the work they perform.
4. Interpersonal Relations: To have students develop concepts and skills in interpersonal relations and apply them to work situations.
5. On-the-Job Communication: To have students understand the importance of effective communication and learn ways of communicating effectively on the job.
6. Using Creativity on the Job: To make students aware of their creative potential and to practice using their creative ability in hypothetical on-the-job situations.
7. Authority and Responsibility: To have students develop an understanding of the concepts of authority, power, influence, and responsibility as they apply to work situations.
8. Problem Solving: To have students develop skill in applying problem solving to their work.
9. Coping with Organizational Change: To make students aware of the process of organizational change and the techniques for coping with organizational change.
10. Coping with Organizational Conflict: To make students aware of the sources and types of conflicts encountered on the job and recognize ways of coping with conflicts in an organization.
11. Leadership: To have students recognize the need for leadership in work groups and increase their understanding of the leadership role in work situations.
12. Adapting and Planning for the Future: To have students develop perspectives of work in the future and the ability to plan for anticipated changes in their work roles."

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*Abstracted from the article, "Survival Skills: Mastering the Human Aspects of Work," by Robert E. Nelson, American Vocational Journal, November 1977.

ELECTRONICS CLUSTER*

Nature of the Work

Television and radio service technicians repair a large and growing number of home electronic products, of which television sets and radios are the most numerous. Stereo components, tape recorders, and even electronic organs also are repaired by these technicians. Some service technicians specialize in repairing one kind of equipment--for example, television sets or car radios. Others repair several types--televisions, video tape machines, intercoms, and public address systems.

Electronic equipment may operate unsatisfactorily for many reasons, such as defective parts, faulty circuits, or poor connections. Service technicians must check and evaluate each possible cause of trouble. They begin by checking common causes such as loose connections. Talking to customers may help technicians identify the problem.

When routine checks do not locate the trouble, technicians refer to wiring diagrams and service manuals that show connections and provide information on how to locate problems. Using test equipment, such as voltmeters, oscilloscopes, and signal generators, they check circuits. For example, they may measure voltages or wave forms in the circuits of a television set for unusual or irregular measurements that indicate the faulty parts. To make repairs, technicians replace faulty parts or make adjustments, such as focusing and converging the picture or correcting the color balance of a television set. In their work, technicians use pliers, soldering irons, wire cutters, and other handtools. Technicians who make customer service calls carry tubes, modules, and other parts that can be easily replaced in the customer's home.

Self-employed service technicians have managerial responsibilities in addition to their regular duties. They have to order equipment and supplies, keep records, and supervise other technicians.

Working Conditions

Service technicians work in shops or customer's homes and working conditions generally are good. They usually work alone and receive little supervision. Technicians who service television sets in homes may do considerable driving. Hazards in the trade include electrical shock and strains from lifting and carrying.

Places of Employment

About 131,000 people worked as radio and television service technicians in 1978. About one-quarter of them were self-employed, a much larger proportion than in most skilled trades. Two-thirds of all service technicians, either self-employed or working for others, worked in television repair shops and stores that sell and service television sets, radios, and other electronic products.

Television and radio service technicians work in almost every city. Geographically, employment is distributed in much the same way as the Nation's population.

Training, Other Qualifications, and Advancement

Training in electronics generally is required to get an entry level job as a television and radio service technician. Training programs include subjects such as mathematics, physics, schematic reading, electricity, and hands-on work with television sets, radios, and other equipment. The training lasts from 1 to 2 years.

The military services offer training and work experience that are very useful in civilian electronics work. However, additional training in television electronics may be required by employers.

New technicians usually begin by working in the shop or in the field under the supervision of an experienced worker. Large repair stores may provide inhouse training to familiarize new workers with particular brands and models of equipment.

Technicians must keep abreast of changes in technology. Manufacturers, employers, and trade associations, such as the National Association of Television and Electronic Servicers of America, conduct training seminars to teach technicians servicing methods for new models or products. Technicians also keep up with developments by studying manufacturers' service manuals and technical magazines.

Television and radio service technicians must be able to manipulate small parts and tools, and must have good eye-hand coordination, normal hearing, and good eyesight and color vision. An ability to work with people is essential in dealing with customers.

Some States require radio and television technicians to be licensed. To obtain a license, applicants must pass an examination designed to test their knowledge of electronic circuits and components and their skill in the use of testing equipment.

Service technicians who work in large repair shops may be promoted to supervisor or service manager. Technicians who have sufficient funds may open their own service shops. Some technicians obtain jobs as electronics "trouble shooters" in manufacturing industries or government agencies.

Those planning to go into business for themselves should take some business administration courses, particularly accounting and consumer relations. Those interested in advancing to positions such as electronics technician can improve their opportunities by taking courses in automatic controls, electronic engineering, television engineering, and mathematics.

Employment Outlook

Employment of Television and radio service technicians is expected to increase faster than the average for all occupations through the 1980's. In addition to openings from employment growth, openings will result each year from the need to replace experienced technicians who retire, die, or change occupations.

Employment of service technicians is expected to increase in response to the growing number of television sets, radios, phonographs, tape recorders, and other home entertainment products, although improvements in technology will reduce service requirements for these products. Rising population and personal incomes will contribute to this growth. Greater use of electronic products for purposes other than entertainment also is expected. For example, closed circuit television is being used increasingly to monitor production processes in manufacturing plants, to protect buildings, and to bring educational programs into classrooms.

People who enter the occupation should have steady work because the television and radio repair business is not very sensitive to changes in economic conditions.

Sources of Additional Information

For more information about jobs in this field, contact local shops and stores that service television sets and radios and other electronic equipment. Technical and vocational schools that offer courses in television and radio repair or electronics may provide information about training. In addition, locals of the International Brotherhood of Electrical Workers and the local office of the State employment service may have information about programs that provide training opportunities.

Information about the work of television and radio service technicians is available from: National Association of Television and Electronic Servicers of America, 5908 S. Troy St., Chicago, Ill. 60629, and from Electronics Industries Association, 2001 Eye St. NW, Washington, D.C. 20006.

*From Occupational Outlook Handbook, 1980-81 ed.

ELECTRONICS CLUSTER PROGRAM OBJECTIVE

Given appropriate instruction, as suggested by this guide, a student completing the program should demonstrate entry level skills in Electronics Cluster in the areas of knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills and occupational survival skills.

As the student progresses through the program, sufficient competencies will be acquired to enable the student to enter the occupational field at the following D.O.T. Codes.*

Electronics Utility Worker	(D.O.T. Code 726.361-010)
Electronics Assembler	(D.O.T. Code 726.684-018)
Electronics Inspector	(D.O.T. Code 726.684-022)
Electronics Tester	(D.O.T. Code 726.684-026)
Audio-Video Repairer	(D.O.T. Code 729.281-010)
Public Address Servicer	(D.O.T. Code 823.261-010)
Radio Repairer	(D.O.T. Code 720.281-010)
Radio Mechanic	(D.O.T. Code 823.261-018)
Television and Radio Repairer	(D.O.T. Code 720.281-018)
Television Installer	(D.O.T. Code 823.361-010)

*Dictionary of Occupational Title, 1977, ed.

DEFINITION OF D.O.T. CODE*

As a result of technological, economic and sociological influences, nearly every job in the economy is performed slightly differently from any other job. Every job is also similar to a number of other jobs. In order to look at the millions of jobs in an organized way, job titles are designated a 9-digit occupational code. Each set of three digits in the D.O.T. Code has a specific purpose or meaning that differentiates it from all other codes.

The first three digits of the D.O.T. Code identify a particular occupational group. In the code 652.382-010, the first digit indicates an occupational category. The second digit refers to a division within the occupational category. The third digit defines a specific occupational group within a division.

The middle three digits of the D.O.T. Code 652.382-010 are the worker function rating of the tasks performed in the occupation. Every job requires a worker to function, to some degree, in relation to data, people and things. A separate digit expresses the worker's relationship to each of these three groups. Worker functions involving more complex responsibility and judgment are assigned lower numbers while functions which are less complicated have high numbers.

The last three digits of the D.O.T. Code 652.382-010 indicate the alphabetical order of titles within 6-digit code groups. They serve to differentiate a particular occupation from all others. A number of occupations may have the same first six digits, but no two D.O.T. Code can have the same nine digits.

*Dictionary of Occupational Titles, 1977 ed.

DESCRIPTION OF OCCUPATIONAL EXIT POINTS*

726.361-010 ELECTRONICS UTILITY WORKER

Arranges layout of work station for other workers who fabricate, process, or assemble electronic equipment, and components, such as semiconductor devices, printed circuit boards, chassis assemblies, and wire harnesses and cables: Reads specifications, such as process guide, bill of material, wiring diagram, mechanical print, and schematic diagram to determine equipment needed, such as piece parts, chemicals and gases, tools, test instruments, and jigs and fixtures, for work stations. Prepares and submits requisition. Positions equipment in specified arrangement at work stations. Notifies stockroom when stations need resupply of materials, such as chemicals, resistors, transistors, and color coded wire, during processing or assembly operations. May assist workers to follow new work procedures, and relieve operators from work stations. May set and adjust controls for processing, fabricating, and assembly line equipment, such as furnaces, process chambers, power supplies, timers, and multimeters. May test and repair assembled items by removing or adding piece parts, or resoldering or rebonding defective connections, using handtools, production equipment, test machines and test instruments, such as meters, resistance brides, and automatic component testers.

726.684-018 ELECTRONICS ASSEMBLER

Assembles electronic components, subassemblies, and systems by any one or combination of following methods: Reads work orders, follows production drawings and sample assemblies, and receives verbal instructions regarding duties to be performed. Positions and alines parts in specified relationship to each other in jig, fixture, or other holding device, using tweezer, vacuum probe, or hand instruments. (1) Tends machines or uses handtools and power tools to crimp, stake, bolt, rivet, weld, solder, cement, press fit, or perform similar operation to secure parts in place. (2) Mounts assembled components such as transformers, resistors, capacitors, integrated circuits, and sockets on chassis, panel or printed circuit board. (3) Connects component lead wires to printed circuit or routes and connects wires between individual component leads and other components, connectors, terminals, and contact points using soldering, welding, thermocompression, or related bonding procedures. (4) Installs finished assemblies or subassemblies in cases and cabinets. (5) Assembles and attaches functional and cosmetic hardware such as caps, clamps, and knobs to assemblies using handtools and power tools. (6) Performs intermediate assemby tasks such as potting, encapsulating, cleaning, coating, epoxy bonding, curing, stamping, etching, impregnating, and color coding parts and assemblies. (7) Tends machines which press or shape component parts such as contacts, shells, and insulators. (8) Tends automatic assembly equipment which joins components and parts. (9) Winds capacitors on manual or automatic winding equipment. (10) Adjusts or trims material from components such as capacitors and potentiometers to change electronic characteristic to specification measured by electronic test instrument. (11) Performs on-line go-not-go testing and inspection using magnifying devices, fixed and moveable measuring instruments, and electronic test equipment to insure parts and assemblies meet production specifications and are free from defects. May perform assembly operations under microscope or other magnifying device. Specific titles may be assigned which designate product, subcomponent, equipment used, or processes.

726.684-022 ELECTRONICS INSPECTOR

Inspects electronic assemblies, subassemblies, parts, and components by comparing them with samples or production illustrations: Examines unit visually for physical defects, such as broken wire, excess solder, holes in sealing material, unevenly wound coil, coating and plating blemishes, oil leaks, faulty resistance weld, scratches, and cracks. Compares wiring and components on assembled circuit board with sample board to verify conformance to specification. Compares hardware, such as eyelets, brackets, and lugs on assemblies, subassemblies and parts with parts list to verify installation. Examines hardware for specified contact with conductor area. Rejects faulty assembly, part, or component. Records type and quantity of defects to keep record control. May measure parts to verify accuracy of dimensions, using standard gages. May use binocular microscope or magnifier to detect defects or verify completeness and size of microcircuitry images. May sort defecttive components and parts for salvage or scrap. May test continuity of printed circuit board, using standard testers or meters. May be designated according to item inspected as CAPACITOR INSPECTOR (electronics); CATHODE-COATING INSPECTOR; CONNECTOR INSPECTOR; FILTER INSPECTOR; GRID INSPECTOR; PRINTED-CIRCUIT-BOARD INSPECTOR. Additional titles: RESISTOR INSPECTOR; SEMICONDUCTOR INSPECTOR; TELEVISION-CHASSIS INSPECTOR; TUBE INSPECTOR.

726.684-026 ELECTRONICS TESTER

Tests electronic function of assemblies, components, and parts, using standard test equipment and procedures: Connects unit to test instrument, such as ohmmeter, voltmeter, ammeter, resistance bridge, or oscilloscope and turns switch. Reads instrument dial or scope that indicates resistance, capacitance, continuity, and wave pattern or defect, such as short or current leakage. Compares instrument reading with standard and rejects defective units. Records type and quantity of defect. May verify dimensions of parts, using standard gages. May examine assembly, component or part for defects, such as short leads, bent plate, or cracked seal. May tend equipment to subject unit to stress and strain prior to testing. May operate X-ray photograph and closed circuit television viewing equipment to observe internal image of unit for assembly defect prior to testing. May adjust circuits in radio and television receivers for maximum signal response and be designated ALINER. May be designated according to unit tested as CAPACITOR TESTER; COIL TESTER; FILTER TESTER; PRINTED-CIRCUIT TESTER; RESISTOR TESTER; TUBE TESTER.

729.281-010 AUDIO-VIDEO REPAIRER

Installs and repairs audio-video equipment, such as tape recorders, public address systems, slide and motion picture projectors, and record players, using handtools, soldering iron, and special testing equipment. Inspects equipment for defects and repairs or replaces parts. Returns equipment to shop for more complicated repairs.

823.261-010 PUBLIC-ADDRESS SERVICER

Installs and repairs sound-amplifying systems used at public and private assemblages, using handtools and electronic test meters: Positions loudspeakers on posts or other supports. Strings cable from loudspeakers to amplifiers. Places microphones in position near speaker, orchestra, or other attraction, and plugs microphone wires into amplifiers. Switches on installation. Listens to sound output and adjusts volume controls or repositions microphones. Tests and repairs equipment in shop, using handtools, soldering iron, and electronic test meters. May test and repair sound recorders, radio and television receivers, and other electronic equipment.

720.281-010 RADIO REPAIRER

Repairs radio receivers, phonographs, recorders, and other electronic-audio equipment, using circuit diagrams and test meters. Tests wiring, tubes, resistors, and other parts, using electronic test equipment, such as voltmeters and oscilloscopes, to locate defects. Replaces defective parts, using handtools, and solders loose connections with soldering iron. May compute charges for labor and materials. May install radios in automobiles. May be designated according to type of radio repaired as AUTOMOBILE RADIO REPAIRER.

823.261-018 RADIO MECHANIC

Tests and repairs radio transmitting and receiving equipment in accordance with diagrams and manufacturer's specifications, using handtools and electrical measuring instruments: Examines equipment for damaged components and loose or broken connections and wires. Replaces defective components and parts, such as tubes, condensers, transformers, resistors, and generator, using handtools. Solders or tightens loose connec-

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tions and cleans and lubricates motor generators. Tests equipment for factors such as power output, frequency power, noise level, audio quality, and dial calibration, using oscilloscopes, radio frequency and watt meters, ammeters, voltmeters, and tube testers. Tests batteries with hydrometer and ammeter and charges batteries. Inserts plugs into receptacles and bolts or screws leads to terminals to connect radios and equipment to power source, using handtools. Turns setscrews to adjust receivers for sensitivity and transmitters for maximum output. Required to have Federal Communications Commission Radiotelephone Operator's license. May install, test, adjust, modify, and repair intercommunication systems. May specialize in testing and repairing radio transmitting and receiving equipment in motor vehicles and commercial and governmental establishments and be designated as RADIO MECHANIC, GROUND INSTALLATION.

720.281-018 TELEVISION-AND-RADIO REPAIRER

Repairs and adjusts radios and television receivers, using handtools and electronic testing instruments: Tunes receiver on all channels and observes audio and video characteristics to locate source of trouble. Adjusts controls to obtain desired density, linearity, focus, and size of picture. Examines chassis for defects. Tests voltages and resistances of circuits to isolate defect, following schematic diagram and using voltmeter, oscilloscope, signal generator, and other electronic testing instruments. Tests and changes tubes. Solders loose connections and repairs or replaces defective parts, using handtools and soldering iron. Repairs radios and other audio equipment. May install television set.

823.361-010 TELEVISION INSTALLER

Installs and adjust television receivers and antennas, using handtools: Selects antenna according to type of set and location of transmitting station. Bolts crossarms and dipole elements in position to assemble antenna. Secures antenna in place with bracket and guy wires, observing insurance codes and local ordinances to protect installation from lightning and other hazards. Drills and waterproofs holes in building to make passages for transmission line. Connects line between receiver and antenna and fastens line in place. Tunes receiver on all channels and adjusts screws to obtain desired density, linearity, focus, and size of picture. Orients antenna and installs reflector to obtain optimum signal reception.

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*Dictionary of Occupational Titles, 1977 ed.

TASK LISTING BY D.O.T. CODE

In this section the occupational exit points from the curriculum are cross referenced with the tasks which are required for employment in each job title. On the line following each task an x appears in the column of each job title to which to task applies. All the tasks listed in this matrix are taught in the curriculum presented in this guide. A detailed treatment of each task appears in the Unit Guides section of this curriculum guide.

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT DESCRIPTION												
	DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
	Basic Skills												
BS-01	Observing electrical safety precautions and first aid practices	X	X	X	X	X	X	X	X	X	X		
BS-02	Using hand tools	X	X	X	X	X	X	X	X	X	X		
BS-03	Using power tools	X	X	X	X	X	X	X	X	X	X		
BS-04	Soldering to terminals and PC boards	X	X	X	X	X	X	X	X	X	X		
BS-05	Selecting, preparing and installing wiring	X	X	X	X	X	X	X	X	X	X		
BS-06	Installing coaxial connectors	X	X	X	X	X	X	X	X	X	X		
BS-07	Performing a visual inspection of electronic equipment	X	X	X	X	X	X	X	X	X	X		
BS-08	Cleaning electronic equipment	X	X	X	X	X	X	X	X	X	X		

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker 726.361-010	Electronics Assembler 726.684-018	Electronics Inspector 726.684-022	Electronics Tester 726.684-026	Audio-Video Repairer 729.281-010	Public Address Servicer 823.261-010	Radio Repairer 720.281-010	Radio Mechanic 823.261-018	Television and Radio Repairer 720.281-018	Television Installer 823.361-010		
	DOT DESCRIPTION / DOT NO.												
BS-09	Lubricating electronic equipment	X	X	X	X	X	X	X	X	X	X		
BS-10	Inspecting and replacing power cords and distribution cables	X	X	X	X	X	X	X	X	X	X		
BS-11	Keeping records on maintenance of equipment	X	X	X	X	X	X	X	X	X	X		
BS-12	Preparing parts lists	X	X	X	X	X	X	X	X	X			
	DC Electronics												
DC-01	Understanding fundamentals of electrical theory and electrical measurement	X	X	X	X	X	X	X	X	X	X		
DC-02	Using volt-ohm milliammeters	X	X	X	X	X	X	X	X	X	X		
DC-03	Using electronic voltmeters (EVM)	X	X	X	X	X	X	X	X	X	X		

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

	DOT DESCRIPTION	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
TASK NO.	TASK NAME												
DC-04	Measuring current in DC circuits	X	X	X	X	X	X	X	X	X	X		
DC-05	Measuring voltage in DC circuits	X	X	X	X	X	X	X	X	X	X		
DC-06	Calculating and measuring resistance in DC circuits	X	X	X	X	X	X	X	X	X	X		
DC-07	Making calculations using Ohm's law	X	X	X	X	X	X	X	X	X			
DC-08	Calculating voltage, current and resistance in DC series circuits	X	X	X	X	X	X	X	X	X			
DC-09	Calculating total voltage, total current and total resistance	X	X	X	X	X	X	X	X	X			
DC-10	Calculating and measuring electrical quantities in combination DC circuits	X	X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT DESCRIPTION / DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
DC-11	Calculating power in DC circuits	X	X	X	X	X	X	X	X	X			
DC-12	Applying fundamentals of magnetism and electromagnetism	X	X	X	X	X	X	X	X	X			
DC-13	Analyzing and modifying meter movements	X	X	X	X	X	X	X	X	X			
DC-14	Calculating values in DC network circuits			X	X	X	X	X	X	X			
DC-15	Calculating capacitance and time constants for RC circuits			X	X	X	X	X	X	X			
	AC Electronics												
AC-01	Calculating values for a right triangle			X	X	X	X	X	X	X			
AC-02	Using oscilliscopes			X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
AC-03	Analyzing AC sine waves			X	X	X	X	X	X	X			
AC-04	Measuring AC values for LF circuits			X	X	X	X	X	X	X			
AC-05	Determining reactance and impedance of capacitors in series and parallel circuits			X	X	X	X	X	X	X			
AC-06	Using capacitor testers			X	X	X	X	X	X	X			
AC-07	Calculating and measuring electrical values in AC capacitance circuits			X	X	X	X	X	X	X			
AC-08	Using impedance testers			X	X	X	X	X	X	X			
AC-09	Measuring inductance in series and parallel RL circuits			X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker 726.361-010	Electronics Assembler 726.684-018	Electronics Inspector 726.684-022	Electronics Tester 726.684-026	Audio-Video Repairer 729.281-010	Public Address Servicer 823.261-010	Radio Repairer 720.281-010	Radio Mechanic 823.261-018	Television and Radio Repairer 720.281-018	Television Installer 823.361-010		
AC-10	Computing turns, voltage, current and impedance ratios of transformers	X		X	X	X	X	X	X	X			
AC-11	Drawing phasor diagrams and calculating operating values for series AC circuits			X	X	X	X	X	X	X			
AC-12	Drawing phasor diagrams and calculating operating values for parallel AC circuits			X	X	X	X	X	X	X			
AC-13	Analyzing tuned AC circiuts			X	X	X	X	X	X	X			
	Semiconductors												
SC-01	Analyzing the characteristics and functions of semiconductors	X	X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker 726.361-010	Electronics Assembler 726.684-018	Electronics Inspector 726.684-022	Electronics Tester 726.684-026	Audio-Video Repairer 729.281-010	Public Address Servicer 823.261-010	Radio Repairer 720.281-010	Radio Mechanic 823.261-018	Television and Radio Repairer 720.281-018	Television Installer 823.361-010		
SC-02	Analyzing the application and operation of semiconductor diodes	X	X	X	X	X	X	X	X	X			
SC-03	Analyzing the application and operation of zener diodes in regulator circuits	X	X	X	X	X	X	X	X	X			
SC-04	Analyzing the application and operation of tunnel, varactor and high frequency diodes	X	X	X	X	X	X	X	X	X			
SC-05	Analyzing the operation of bipolar transistors	X	X	X	X	X	X	X	X	X			
SC-06	Analyzing the operation of field effect transistors			X	X	X	X	X	X	X			
SC-07	Analyzing the operation of thyristors			X	X	X	X	X	X	X			
SC-08	Analyzing the operation of integrated circuits			X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT DESCRIPTION / DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
SC-09	Analyzing the operation of optoelectronic devices			X	X	X	X	X	X	X			
	Vacuum Tubes												
VT-01	Analyzing the operation of diode vacuum tubes			X	X	X	X	X	X	X			
VT-02	Analyzing the operation of triode vacuum tubes			X	X	X	X	X	X	X			
VT-03	Analyzing the operation of tetrode vacuum tubes			X	X	X	X	X	X	X			
VT-04	Analyzing the operation of pentode vacuum tubes			X	X	X	X	X	X	X			
VT-05	Inspecting and replacing vacuum tubes			X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
	Electronic Circuits I												
EC-01	Analyzing common emitter amplifier circuits			X	X	X	X	X	X	X			
EC-02	Analyzing the operation of DC and audio amplifiers			X	X	X	X	X	X	X			
EC-03	Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers			X	X	X	X	X	X	X			
EC-04	Testing amplifiers for amplification			X	X	X	X	X	X	X			
EC-05	Testing and repairing vacuum tube amplifiers			X	X	X	X	X	X	X			
EC-06	Testing and repairing transistor amplifiers			X	X	X	X	X	X	X			
EC-07	Analyzing power supply circuits			X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT DESCRIPTION / DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
EC-08	Testing and repairing power supplies			X	X	X	X	X	X	X			
EC-09	Calibrating power supply voltage			X	X	X	X	X	X	X			
	Electronic Circuits II												
EC-10	Analyzing the operation of oscillators			X	X	X	X	X	X	X			
EC-11	Testing and repairing oscillators			X	X	X	X	X	X	X			
EC-12	Testing and repairing counter circuits			X	X	X	X	X	X	X			
EC-13	Analyzing pulse circuits			X	X	X	X	X	X	X			
EC-14	Testing and repairing nonsinusoidal amplifiers			X	X	X	X	X	X	X			
EC-15	Analyzing amplitude modulator (AM) circuits			X	X	X	X	X	X	X			
EC-16	Analyzing frequency modulator (FM) circuits			X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
EC-17	Analyzing the operation of superheterodyne receivers			X	X	X	X	X	X	X			
	Servicing Components												
EC-18	Servicing tape recorders					X	X	X	X	X			
EC-19	Servicing record changers					X	X	X	X	X			
EC-20	Inspecting and repairing loudspeakers					X	X	X	X	X			
EC-21	Inspecting and repairing microphones					X	X	X	X	X			
EC-22	Laying out, taping up and drawing basic printed circuit boards		X	X		X	X	X	X	X			
EC-23	Constructing printed circuit (PC) boards		X	X		X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
	Television I												
TV-01	Analyzing the stages of a black and white												
	TV receiver									X			
TV-02	Analyzing low voltage power supplies									X			
TV-03	Troubleshooting switch-mode secondary voltage												
	supplies									X			
TV-04	Troubleshooting sychronizing and deflection												
	circuits									X			
	Television II												
TV-05	Troubleshooting horizontal output circuits									X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
DOT NO.	DOT DESCRIPTION	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
TV-06	Troubleshooting sweep-generator circuits									X			
TV-07	Troubleshooting high voltage supplies									X			
TV-08	Aligning the CRT and associated circuits									X			
TV-09	Troubleshooting vertical deflection circuits									X			
TV-10	Adjusting the purity, focus and gray scale to produce a normal raster									X			
TV-11	Analyzing the operation of video amplifiers									X			
TV-12	Troubleshooting defective video amplifiers									X			
TV-13	Analyzing video IF amplifiers									X			
TV-14	Aligning RF and IF amplifiers									X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME												
	DOT DESCRIPTION	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
TV-15	Analyzing the operation of sound IF and AM circuits									X			
TV-16	Aligning sound IF and AM circuits									X			
TV-17	Analyzing VHF and UHF tuner circuits									X			
TV-18	Analyzing automatic fine tuning (AFT) and remote control circuits									X			
TV-19	Analyzing automatic gain control (AGC) and noise canceling circuits									X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

POSSIBLE EXIT POINTS

	DOT DESCRIPTION	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer		
	DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010		
TASK NO.	TASK NAME												
	TV Color Section												
TV-20	Analyzing color television signal reception and decoding									X			
TV-21	Testing picture tubes and associated circuits									X			
TV-22	Analyzing band-pass amplifiers, color killer circuits and automatic color control circuits									X			
TV-23	Analyzing color sync circuits									X			
TV-24	Analyzing color demodulator and output amplifier circuits									X			
TV-25	Troubleshooting defective color tuning circuits									X			

TASK LISTING BY DOT CODE

ELECTRONICS CLUSTER

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS DOT DESCRIPTION: Electronics Utility Worker DOT NO.: 726.361-010	Electronics Assembler 726.684-018	Electronics Inspector 726.684-022	Electronics Tester 726.684-026	Audio-Video Repairer 729.281-010	Public Address Servicer 823.261-010	Radio Repairer 720.281-010	Radio Mechanic 823.261-018	Television and Radio Repairer 720.281-018	Television Installer 823.361-010		
TV-26	Analyzing and adjusting color convergence circuits									X			

PERFORMANCE STANDARDS REQUIRED FOR GRADUATION

Students are required, by the State Board of Education to demonstrate competency in the adult life roles of the learner, individual, citizen, consumer and producer. The performance standards for the adult life role of the learner will be measured statewide. The local Boards of Education are required to adopt and validate performance indicators for the adult life roles of the individual, citizen, consumer and producer.

Performance Standards (State Board of Education)

A. Learner

1. The student reads and interprets communication on a functional level.
2. The student comprehends information received and applies that information in a variety of everyday situations.
3. The student writes legible appropriate personal and career communications on a functional level.
4. The student receives and transmits oral and visual communications on a functional level.
5. The student employs estimation, approximation and calculation skills in everyday living situations.
6. The student understands and uses various forms of scales and measurements, graphs, charts, tables, symbols and other graphic representations.
7. The student applies basic arithmetic operations (adding, subtracting, multiplying and dividing) in an everyday context.
8. The student applies basic geometric shapes and positions necessary for daily mathematical functions.
9. The student uses a variety of information resources to obtain assistance and information.
10. The student employs logical, intuitive and creative thinking processes.

Performance Standards (Local Board of Education)

B. Individual

1. The student knows appropriate emergency responses to accidents and demonstrates preventive actions for health and safety hazards.

2. The student recognizes and practices sound personal health habits necessary to maintain physical and mental well-being.

3. The student understands the sound health care principles involved in family living, parenting and parenthood.

C. Citizen

1. The student understands the basic structure and functions of the American system of Government and the American economic system.

2. The student knows basic legal rights and responsibilities of the citizen under the American judicial and penal systems.

3. The student recognizes relationships between current societal and environmental problems and the individual's role and responsibilities.

D. Consumer

1. The student knows the principles of sound personal financial planning and management.

2. The student identifies the legal rights and responsibilities of the consumer in buying and selling goods and services.

E. Producer

1. The student analyzes personal career opportunities and choices through career planning and management.

2. The student demonstrates the skills necessary to obtain employment.

Program Competencies

This program will provide opportunities for the student to demonstrate competencies in the following performance standards. The standards are "keyed" to the above list by letter and number (i.e. A-1, 4, 9; B-3; C-1; etc.).

Performance Standards: A-1, 2, 4, 5, 6, 7, 9 and 10; B-1; E-2

SECTION III

UNIT GUIDES

SECTION III

Section III Content List

Unit Guide Description
Suggested Sequence of Unit Guides

In Section II, the occupational area was introduced. Section III continues this development by presenting, for each task, a unit guide for instructional planning and execution.

The instruction of specific tasks is central to vocational education. However, the value of a single task/competency to the student as a prospective member of the workforce is dependent upon the way in which that task/competency is related to other tasks and to the entire occupational area. Therefore, the Electronics Cluster Program Task Listing provides a sample organizational model for sequencing the instruction of program tasks.

UNIT GUIDES DESCRIPTION

In this section the tasks to be taught in each course are presented in sequential order. Each task is listed on a separate page so that it may be taken out of the guide for daily lesson planning or regrouped with order tasks to fit the individual teacher's preference for teaching order. The task pages may be used for planning and executing group instruction or for individualized instruction. Each page in the UNIT GUIDES section contains the following information:

TASK: This is a short and concise statement of the task to be taught.

PERFORMANCE OBJECTIVE: The performance expected of the student after completing the unit is stated in stem form, without a specific statement of all conditions, equipment and performance standard (these are listed in a criterion referenced measure in the Evaluation section of the task page).

INSTRUCTIONAL ACTIVITIES: Suggested learning activities are presented. These activities include providing information, demonstration, practical applications and projects.

INSTRUCTIONAL MATERIALS: Suggested materials for carrying out the instructional activities are listed. these include textbooks, audiovisuals and equipment. Textbooks are referenced by author and title with the complete reference contained in the textbook list in the Instructional Resources section.

EVALUATION: This section contains a criterion referenced measure and reference to any test items or other evaluation measures that are available to teacher.

CLASS/LAB HOURS: The estimated time for completion of the instructional activities and the evaluation are indicated in both classroom and lab hours. Total instructional time would be the sum of these.

RADIO-TV TASK INDEX

BASIC SKILLS

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TASK

BS-01 Observing electrical safety precautions and first aid practices

PERFORMANCE OBJECTIVE

Observe all electrical safety precautions and first air practices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hazards from clothing
b. Hazards from hair
c. Hazards from jewelry
d. Chemical hazards
e. Use of protective clothing and equipment
f. Soldering iron safety
g. Lifting heavy objects
h. Types and uses of fire extinguishers
i. Switches and breaker panels
j. Safe use of power tools
k. Maintaining a safe work area
l. Fire evacuation procedures
m. Artificial respiration techniques

Provide Demonstration On:

a. Types and uses of fire extinguishers
b. Artificial respiration
c. Fire evacuation plans

Provide Practical Application On:

a. Developing a safety checklist
b. Use of fire extinguishers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Georgia, Electronics Technology, Phase A, Unit 3-A
c. MAVVC, Basic Electronics 1
d. Heathkit, DC Electronics

A/Vs:

a. Career Aids, Inc., "Electrical Safety in the Shop," filmstrip

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Student Manuals:

a. Heathkit, DC Electronics, Student Workbook
b. Georgia, Electronics Technology, Phase A, Unit 3-A

LAB HOURS	4
CLASS HOURS	2

EVALUATION (BS-01)

a. Given electrical safety rules for the shop, the student will identify and describe electrical safety procedures and devices according to the instructor's specifications.

b. Heathkit, DC Electronics, Student Workbook.

c. MAVCC, Basic Electronics 1.

d. Georgia, Electronics Technology, Phase A, Student Tests.

INSTRUCTIONAL MATERIALS

A/Vs:

b. Career Aids, Inc., "Electricity/Electronics," filmstrip
c. Georgia, Electronics Technology, Phase A, Unit 3-A, "Safety and Shop Practices," slide/tape

TASK

BS-02 Using hand tools

PERFORMANCE OBJECTIVE

Identify and use hand tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Screwdrivers
   1. Flat blade
   2. Phillips
   3. Socket head
   4. Offset

b. Hammers

c. Wrenches
   1. Adjustable end wrench
   2. Pipe wrench
   3. Open end wrench
   4. Box end wrench
   5. Combination wrenches
   6. Socket wrenches, ratchet handle and speed handle
   7. Torque wrench
   8. Safety

d. Pliers
   1. Slip-joint pliers
   2. Water-pump pliers
   3. Grooved or arc joint pliers
   4. Locking pliers
   5. Safety

e. Hacksaws

f. Punches and chisels
   1. Center punch
   2. Aligning punch
   3. Drift punch
   4. Gasket punch

g. Drills

h. Files

i. Tin snips

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Dover Publications, Inc., Tools and Their Uses

b. MAVCC, Basic Electronics 1

A/Vs:

a. Hobar, "Hammer, Nails and Nailing Techniques" and "Screws and Driving Tools," slide tape

b. Career Aids, Inc., "Using Hand Tools, Part 1," and "Using Hand Tools, Part 2," transparencies

Tools and Equipment:

a. Screwdrivers

b. Hammers

c. Chisels and punches

d. Hacksaws

e. Wrenches

f. Pliers

g. Drills

h. Taps and dies

i. Files

j. Tin snips

LAB HOURS	5
CLASS HOURS	1

EVALUATION (BS-02)

Given a selection of hand tools, the student will accurately identify each tool, describe its use and identify safe use practices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Taps and dies
   1. Taper
   2. Plug
   3. Bottoming
   4. T-handle
   5. Straight handle

k. Hand tool safety

TASK

BS-03 Using power tools

PERFORMANCE OBJECTIVE

Identify and use power tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safe use of power tools
    1. Personal safety
    2. Electrical safety
b. Hand drill
    1. Chuck
    2. Drill safety
c. Drill press
    1. Safety
    2. Drill bit selection
    3. Work holding devices
    4. Center drilling
d. Bench grinders
    1. Safety
    2. Dressing the wheel
    3. Types of work

Provide Demonstration On:

Proper use of power tools

Provide Practical Application On:

Basic operation of power tools

INSTRUCTIONAL MATERIALS

Textbooks:

Dover Publications, Inc., Tools and Their Uses

A/Vs:

Hobar, "Safety: Machine and Power Tools," transparencies

Tools and Equipment:

a. Drills
b. Drill press
c. Bench grinder

LAB HOURS 11

CLASS HOURS 1

EVALUATION (BS-03)

Given a selection of power tools, the student will accurately identify each tool, describe its use and identify safety rules for operation of the tool. The following tools will be used:

1. Drills
2. Drill press
3. Bench grinder

TASK

BS-04 Soldering to terminals and PC boards

PERFORMANCE OBJECTIVE

Solder wires and components to terminals and PC boards.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of soldering devices
b. Types of solder
c. Types of PC boards and terminals
d. Types of de-soldering tools and materials
e. Proper soldering and de-soldering techniques
f. Tinning
g. Cold soldering

Provide Demonstration On:

a. Types of solder and soldering devices
b. Proper soldering and de-soldering techniques

Provide Practical Application On:

Soldering and de-soldering wires and components to terminals and PC boards

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duarte and Duarte, Electronics Assembly and Fabrication Methods
b. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Soldering Principles," slide/tape 5-A

Student Manuals:

Georgia, Electronics Technology, Phase A, Unit 5-A

Tools and Equipment:

a. Soldering iron and supplies
b. Assorted wire and cable
c. PC board
d. 8 pin connector plug

LAB HOURS 8

CLASS HOURS 2

EVALUATION (BS-04)

Given a practice set of terminals and a practice PC board, the student will correctly

a. Mount stranded and solid wires to a terminal strip and solder them
b. Mount components such as resistors and capacitors to a PC board and solder them
c. Remove the above components and clean the terminals and PC board

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TASK

BS-05 Selecting, preparing and installing wiring

PERFORMANCE OBJECTIVE

Identify wire types, prepare for soldering and install wiring.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wire gauges
b. Wire types
c. Use of wire tables
d. Cables
e. Lacing
f. Soldering to terminals and connector plugs
g. Use of wiring harness

Provide Demonstration On:

a. Types of wiring
b. Proper preparation and installation techniques

Provide Practical Application On:

a. Wire stripping
b. Cable lacing
c. Choosing proper wire for a given application

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Duarte and Duarte, Electronics Assembly and Fabrication Methods
c. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Wire, Tools and Wirestripping," slide/tape 4-A

Student Manuals:

Georgia, Electronics Technology, Phase A, Units 4-A and 6-A

Tools and Equipment:

a. Board containing a terminal strip and one connector plug
b. 6 lengths of stranded hook-up wire 12" long

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LAB HOURS 14

CLASS HOURS 2

EVALUATION (BS-05)

a. Given wire strippers and an assortment of wires, the student will correctly identify the types of wire and properly strip the insulation from the wire samples. The student will also prepare a length of coaxial cable for soldering.

b. Given a set of wire tables, the student will correctly state the ohms per 1000 feet of any size wire called for by the instructor.

c. Given cable lacing materials, the student will demonstrate to the instructor, the correct way to make up a cable, using lacing cord and the proper knots.

INSTRUCTIONAL MATERIALS

Tools and Equipment.

c. 3 lengths of solid wire, various diameters
d. Soldering equipment
e. Wire strippers
f. Spot ties
g. Sleeving

TASK

BS-06 Installing coaxial connectors

PERFORMANCE OBJECTIVE

Install common types of coaxial cable connectors on transmission line.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Need for connectors
b. Coax connector types
   1. BNC
   2. Type N
   3. PL-259
c. Proper installation techniques
d. Adapter sleeves for connectors

Provide Demonstration On:

Examples of proper connector installation

Provide Practical Application On:

a. Installation of BNC, Type N and PL-259 on coax cable ends
b. Checking for continuity and shorts with the ohmmeter to be sure the cable and connector are electrically OK

INSTRUCTIONAL MATERIALS

Textbooks:

ARRL, Radio Amateur's Handbook

Tools and Equipment:

a. Coax connectors
b. Coax cable
c. Soldering iron and supplies
d. VOM

LAB HOURS	6
CLASS HOURS	

EVALUATION (BS-06)

Given 3 common types of coax connectors and 3 lengths of coax cable, the student will correctly

1. Install the connectors, one on each length of cable
2. Check for electrical problems - shorts and opens in the connector

The cable must be installed mechanically in accordance with the standard practices given in the ARRL Handbook and there must be no open circuit or short circuit conditions within the connector or the cable.

TASK

BS-07 Performing a visual inspection of electronic equipment

PERFORMANCE OBJECTIVE

Perform a visual inspection of electronic equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. How to inspect equipment for physical damage (rough handling)
b. How to identify possible danger signs
    1. Circuit overheat
    2. Cracked insulation
    3. Dust and dirt
    4. Fatigue fractures
    5. Loose lock nuts, set screws
    6. Evidence of arcing
    7. Broken wiring
    8. Broken components
    9. Unusual odor

Provide Demonstration On:

a. Inspecting equipment for physical damage
b. Identifying possible danger signals

Provide Practical Application On:

a. Inspecting equipment for physical damage
b. Identifying possible danger signals

INSTRUCTIONAL MATERIALS

Textbooks:

Equipment service manuals

Tools and Equipment:

a. Screwdrivers
b. Inspection manual
c. Inspection probe (non-conductive)
d. Flashlight
e. Compressed air (optional)
f. Goggles/safety glasses
g. Checklist

LAB HOURS	10
CLASS HOURS	

EVALUATION (BS-07)

Given guidelines, tools and supplies for performing a visual inspection of known equipment, the student will perform a visual inspection and record the condition of the equipment.

TASK

BS-08 Cleaning electronic equipment

PERFORMANCE OBJECTIVE

Clean electronic equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cleaning standards
   1. Exterior (cabinets)
   2. Interior (chassis)
   3. Operator controls
   4. "Dirt free" components/areas
   5. Face of CRT
   6. Movable hardware

b. Types of cleaning supplies
   1. Compressed air
   2. Solvents
   3. Water
   4. Brushes (various)
   5. Paper towels
   6. Cloth rags
   7. Anti-static solution
   8. Cotton swabs
   9. Lens tissue

Provide Demonstration On:

Cleaning electronic equipment

Provide Practical Application On:

Cleaning electronic equipment

INSTRUCTIONAL MATERIALS

Textbooks:

a. Equipment service manuals
b. Solvent specifications

Tools and Equipment:

a. Screwdrivers
b. Inspection mirror
c. Inspection probe (nonconductive)
d. Inspection light
e. Compressed air
f. Goggles/safety glasses
g. Checklist
h. Solvents
i. Water

(Continued on back)

LAB HOURS 12

CLASS HOURS

EVALUATION (BS-08)

a. Given equipment, tools and supplies; the student will clean electronic equipment to required standards and record steps taken on a checklist. Equipment must meet standards demonstrated by the instructor or stated on the checklist.

b. V'TECS, Electronics Mechanics, Task No. E-02 - E-13.

c. V'TECS, Radio-Television, Task No. 159.

d. V'TECS, Radio Communications Technician, Tasks No. 22 and 43.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

j. Brushes
k. Paper towels
l. Cloth rags
m. Anti-static solution
n. Cotton swabs

TASK

BS-09 Lubricating electronic equipment

PERFORMANCE OBJECTIVE

Lubricate electronic equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of lubricants
  1. Non-conductive
  2. Conductive
  3. For high heat areas
  4. By viscosity rating
b. Types of materials lubricants used on
  1. Metals
  2. Plastics
  3. Plant fiber
  4. Carbon surface
c. Tools for application
  1. Oilers (various)
  2. Drop tube (straw)
  3. Paddles
  4. Probes
  5. Pads
  6. Tubes of grease

Provide Demonstration On:

Lubricating electronic equipment

Provide Practical Application On:

Lubricating electronic equipment

INSTRUCTIONAL MATERIALS

Textbooks:

a. Equipment service manuals
b. Lubricant specifications

Tools and Equipment:

a. Handtools
b. Inspection mirror
c. Inspection probe (non-conductive)
d. Inspection light
e. Checklist
f. Oilers (various)
g. Drop tube (straw)
h. Paddles (various sizes)
i. Probes
j. Cloth rags

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LAB HOURS 18

CLASS HOURS

EVALUATION (BS-09)

a. Given equipment, tools and supplies; the student will lubricate electronic equipment to required standards and record steps taken on a checklist. Equipment must meet standards demonstrated by the instructor or stated on the checklist.

b. V'TECS, Radio-Television, Task No. 56.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

k. Cleaning pads
l. Tubes of grease

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TASK

BS-10 Inspecting and replacing power cords and distribution cables

PERFORMANCE OBJECTIVE

Inspect and replace power cords and distribution cables.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Materials used
   1. Cords
   2. Cables
   3. Cable ties
   4. Clamps
   5. Connectors
   6. Lacing
b. Assembly methods
c. Possible damage
   1. Physical abuse
   2. Electrical overload
d. Visual inspections
e. Testing with instruments
   1. VOM
   2. Reflectometer

Provide Demonstration On:

a. Cords and cable sets
b. Referencing standards and recording maintenance actions
c. Performing conditions test

Provide Practical Application On:

a. Performing condition tests
b. Referencing standards and recording maintenance actions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duarte, *Electronics Assembly and Fabrication Methods*
b. Equipment service manual
c. Test equipment operation manual
d. Parts catalogs

Tools and Equipment:

a. Screwdrivers
b. Wrenches
c. Soldering iron
d. Solder
e. Pliers
f. Flashlight
g. Solder remover
h. VOM
i. Reflectometer
j. Cord and/or wiring

LAB HOURS	12
CLASS HOURS	

EVALUATION (BS-10)

a. Given power cords, distribution cables, tools, supplies and test instruments, the student will inspect and repair cords and cables to required standards, as either demonstrated by the instructor or stated on the checklist.

b. V'TECS, Electronics Mechanics, Task No. E-19.

c. V'TECS, Radio Communications Technician, Task No. 19.

TASK

BS-11 Keeping records on maintenance of equipment

PERFORMANCE OBJECTIVE

Keep records on maintenance of equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Guidelines for recordkeeping
b. Selection of significant information for recording
c. Administrative procedures for storage and retrieval of records
d. Guidelines for discarding records
e. Types of records (card files, logs, etc.)

Provide Demonstration On:

a. Using guidelines to select significant information
b. Method of recordkeeping
c. Disposal procedures

Provide Practical Application On:

a. Gathering significant data for recording
b. Making entries reflecting maintenance actions on past tasks
c. Establishing a disposal date

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Guidelines for recordkeeping
b. Record log
c. Data for tasks selected by instructor

LAB HOURS 18
CLASS HOURS 6

EVALUATION (BS-11)

a. Given guidelines and data of past maintenance actions, the student will prepare a record of significant maintenance information and establish a date for disposal.

b. V'TECS, Electronic Mechanics, Task No. C-24.

c. V'TECS, Radio-Television, Task No. 175.

d. V'TECS, Radio Communications Technician, Task No. 72.

TASK

BS-12 Preparing parts lists

PERFORMANCE OBJECTIVE

Prepare parts lists.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electronic master parts catalog
b. Manufacturer's parts catalog
c. Electronic supply houses
d. Parts substitution

Provide Demonstration On:

a. Locating electronic parts in a catalog
b. Locating mechanical parts in a manufacturer's catalog
c. Finding dealer for parts not listed in catalogs
d. Parts substitution

Provide Practical Application On:

Preparing a parts list that would be needed to construct a given electronic circuit

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Catalogs
b. Electronic assembly or schematic
c. Paper, pencil
d. Samples of parts lists

LAB HOURS	24
CLASS HOURS	6

EVALUATION (BS-12)

a. Given an electronic chasis or schematic, the student will construct a parts list that will be sufficient to build the electronic system.

b. V'TECS, Electronics Mechanics, Task No. C-16.

TASK

DC-01 Understanding fundamentals of electrical theory and electrical measurement

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of the fundamentals of electrical theory and the use of electric test meters and circuit diagram symbols.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Atoms
b. Electrons
c. Voltage
d. Current
e. Resistance
f. Electrical measurements and circuits
    1. Ammeter
    2. Voltmeter
    3. Ohmmeter
    4. Circuits
    5. Fuses
    6. Symbols
    7. Circuit diagrams

Provide Demonstration On:

Electric test meters

Provide Practical Application On:

Making basic electrical measurements in a DC circuit using test meters

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. MAVCC, Basic Electronics 1
c. Singer, Basic Mathematics for Electricity and Electronics
d. Georgia, Electronics Technology, Phase A

Student Manuals:

Georgia, Electronics Technology, Phase A, Unit 9-A

Tools and Equipment:

a. Ammeter
b. Voltmeter
c. Ohmmeter
d. Fuses
e. Live DC circuits

LAB HOURS	4
CLASS HOURS	8

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EVALUATION (DC-01)

a. Given a diagram of an atom, the student will correctly identify electrons, protons, neutrons, the nucleus and orbit.

b. Given a list of basic electrical terms and definitions covered in the unit, the student will correctly match each term with its definition.

c. Given a chart of electrical symbols covered in the unit, the student will correctly identify all symbols on the chart.

d. Given a set of circuit diagrams covered in the unit, the student will correctly identify the components in each diagram.

e. Given an ammeter, a voltmeter and an ohmmeter, the student will correctly identify each meter and describe its basic function as covered in the unit.

f. Test and review questions are available in:
   1. Singer, Basic Mathematics for Electricity and Electronics, Chapter 1.
   2. MAVCC, Basic Electronics 1, Unit 1.
   3. Georgia, Electronics Technology, Phase A, Student Tests, Unit 9-A.
   4. Grob, Basic Electronics.

TASK

DC-02 Using volt-ohm milliammeters (VOM)

PERFORMANCE OBJECTIVE

Identify the operating controls of the VOM, correctly set up the controls for voltage, current and resistance measurements and read the meter scale.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. VOM safety
b. VOM control settings
c. VOM scale interpretation

Provide Demonstration On:

a. Safe use of a VOM
b. How to correctly connect and read the VOM in measuring voltage, current and resistance

Provide Practical Application On:

a. Identifying VOM safety
b. Setting VOM controls for voltage, current and resistance measurements
c. Measuring and reading assigned voltage, current and resistance

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Gilli, Electrical Principles for Electronics
c. Heathkit, DC Electronics
d. MAVCC, Basic Electronics 1

A/Vs:

Georgia, Electronics Technology, Phase A, "Use and Care of the VOM and VTVM," slide/tape 14-A

Student Manuals:

a. Heathkit, DC Electronics, Student Workbook
b. Georgia, Electronics Technology, Phase A, Unit 14

Tools and Equipment:

a. VOM
b. Circuit to provide voltage, current and resistance measurements

LAB HOURS 6

CLASS HOURS

EVALUATION (DC-02)

a. Given a VOM and an assigned circuit, the student will correctly set and connect the VOM to the circuit and make accurate measurements of current, resistance and voltage.

b. Heathkit, DC Electronics, Student Workbook.

c. MAVCC, Basic Electronics 1.

d. Georgia, Electronics Technology, Phase A, Student Tests.

TASK

DC-03 Using electronic voltmeters (EVM)

PERFORMANCE OBJECTIVE

Identify the operating controls on the EVM and set up the controls for voltage current and resistance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. EVM safety
b. EVM control functions
c. EVM interpretation

Provide Demonstration On:

a. EVM safety
b. Connecting and reading an EVM to measure current, resistance and voltage

Provide Practical Application On:

a. Listing EVM safety rules/procedures
b. Setting up and reading current, resistance and voltage using the EVM

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Gilli, Electrical Principles for Electronics
c. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Use and Care of the VOM and VTVM," slide/tape

Tools and Equipment:

a. EVM
b. Circuit to provide voltage, current and resistance measurements

LAB HOURS	6
CLASS HOURS	

EVALUATION (DC-03)

a. Given an EVM and an assigned circuit, the student will correctly set up the controls and accurately measure current, resistance and voltage.

b. Heathkit, DC Electronics, Student Workbook.

c. MAVCC, Basic Electronics 1.

d. Georgia, Electronics Technology, Phase A, Student Tests.

TASK

DC-04 Measuring current in DC circuits

PERFORMANCE OBJECTIVE

Measure current in DC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Composition of matter
b. Electrostatics
   1. Coulomb's Law
   2. Ions
   3. Sources of electricity
c. Current flow
   1. Conductors and insulators
   2. Batteries
   3. Random drift and directed drift
d. Electric circuit
e. Measuring current
   1. The coulomb
   2. Powers of ten and scientific notation

(Continued on back)

Provide Practical Application On:

Measuring direct current in a live circuit using a VOM

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. MAVCC, Basic Electronics 1
c. Singer, Basic Mathematics for Electricity and Electronics
d. Heathkit, DC Electronics
e. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Measuring Electrical Current," slide/tape 10-A

Student Manuals:

a. Heathkit, DC Electronics, Student Workbook
b. Georgia, Electronics Technology, Phase A, Units 10-A and 13-A

LAB HOURS 2

CLASS HOURS 4

EVALUATION (DC-04)

a. Given a live DC circuit and a VOM, the student will correctly measure and compare amperage readings at two points on the circuit. The student will correctly convert amps to milliamps and microamps.

b. Test and review questions can be found in:
   1. Heathkit, DC Electronics, Unit 1 and Student Workbook, Unit 1.
   2. Singer, Basic Mathematics for Electricity and Electronics, Chapter 3.
   3. MAVCC, Basic Electronics 1, Unit II.
   4. Georgia, Electronics Technology, Phase A, Student Tests, Units 10-A and 13-A.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   3. The ampere, milliamps and microamps
   4. Ammeters

f. Changing units of measurement

TASK

DC-05 Measuring voltage in DC circuits

PERFORMANCE OBJECTIVE

Measure voltage in DC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Voltage
b. Electromotive force
c. Potential difference
d. Batteries
   1. Dry cell
   2. Lead-acid
e. Battery connections
   1. Series aiding
   2. Series opposing
   3. Parallel
f. Voltage rises and voltage drops
g. The concept of ground
h. Measuring voltage
i. Shorts and opens

Provide Demonstration On:

a. Measuring voltage
b. Voltage rises and voltage drops
c. Shorts and opens

Provide Practical Application On:

Measuring voltage rises and drops

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. MAVCC, Basic Electronics 1
c. Heathkit, DC Electronics
d. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Measuring Electrical Voltage," slide/tape 11-A

Student Manuals:

a. Heathkit, DC Electronics, Student Workbook
b. Georgia, Electronics Technology, Phase A, Units 11-A and 24-A
c. Meade, Programmed Projects

Tools and Equipment:

a. ET-3100 Electronic Design Experimenter or equivalent

(Continued on back)

LAB HOURS 2

CLASS HOURS 4

EVALUATION (DC-05)

a. Given a live DC circuit and a voltmeter, the student will correctly measure the applied voltage and voltage drops.

b. Test and review questions can be found in:
   1. Heathkit, DC Electronics, Unit 2 and Student Workbook, Unit 2.
   2. MAVCC, Basic Electronics 1, Unit X.
   3. Georgia, Electronics Technology, Phase A, Student Tests, Units 11-A and 24-A.
   4. Grob, Basic Electronics.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Voltmeter with test leads
c. 1000 ohm, 1%, ½-watt resistor
d. 2 1000 ohm, 5%, ½-watt resistors
e. Slide switch
f. Soldering iron and solder

TASK

DC-06 Calculating and measuring resistance in DC circuits

PERFORMANCE OBJECTIVE

Calculate and measure resistance in DC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The ohm
b. Resistivity
c. Conductance
d. Factors determining resistance
e. Resistors
    1. Types
    2. Connecting
f. Measuring resistance
    1. In series
    2. In parallel
g. Light dependent resistors
h. Resistor color code

Provide Demonstration On:

a. Types of resistors
b. Measuring resistance

Provide Practical Application On:

a. Color codes
b. Using the ohmmeter
c. Measuring resistance
d. Light dependent resistors

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Basic Electronics 1
b. Heathkit, DC Electronics
c. Georgia, Electronics Technology, Phase A

A/Vs:

a. Georgia, Electronics Technology, Phase A, "Resistor Color Code," slide/tape 8-A (Part #1)

(Continued on back)

Student Manuals:

a. Heathkit, DC Electronics Student Workbook
b. Georgia, Electronics Technology, Phase A, Units 8-A and 12-A

Tools and Equipment:

a. Assorted resistors
b. VOM
c. Variable DC power supply

LAB HOURS	9
CLASS HOURS	3

EVALUATION (DC-06)

a. Given a live DC resistive circuit and an ohmmeter, the student will accurately identify the resistor types and values in the circuit, compute the resistance in the circuit and measure the resistance in the circuit.

b. The student will correctly identify the value of each color in the resistor color code, the meaning of each color band on a resistor and will accurately give the resistance, tolerance and wattage of assorted resistors supplied by the instructor.

c. Test and review questions can be found in:
   1. Heathkit, DC Electronics, Unit 3 and Student Workbook Unit 3.
   2. Georgia, Electronics Technology, Phase A, Student Tests, Units, 8-A and 12-A.
   3. MAVCC, Basic Electronics 1, Units X and XI.
   4. Grob, Basic Electronics.

INSTRUCTIONAL MATERIALS

A/Vs:

b. Georgia, Electronics Technology, Phase A, "Use of the Ohmmeter," slide/tape 8-A (Part #2)
c. Georgia, Electronics Technology, Phase A, "Using the Ohmmeter to Troubleshoot," slide/tape 12-A

Tools and Equipment:

d. 200 ohm potentiometer
e. 120 ohm potentiometer
f. 100 K ohm thermistor
g. Incandescent lamp #49
h. Lamp socket
i. 1/16-amp fuse
j. ET-3100 Electronic Design Experimenter or equivalent
k. Light dependent resistor
l. 220 ohm, 2-watt, 10% resistor

TASK

DC-07 Making calculations using Ohm's law

PERFORMANCE OBJECTIVE

Make calculations using Ohm's law.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Fractions
b. Ohm's law
c. Decimal numbers
d. The metric system
e. Formulas
f. Positive and negative numbers
g. Exponents
h. Equations

Provide Practical Application On:

a. Solving for electrical values using Ohm's law
b. Experimentally verify Ohm's law calculations
c. Solving algebraic equations using exponents

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Basic Electronics 1
b. Singer, Basic Mathematics for Electricity and Electronics
c. Georgia, Electronics Technology, Phase A
d. Grob, Basic Electronics

Student Manuals:

a. Meade, Programmed Projects
b. Georgia, Electronics Technology, Phase A, Unit 15-A

Tools and Equipment:

a. VOM
b. Basic Electricity/Electonics Trainer
c. Variable voltage DC supply

LAB HOURS	
CLASS HOURS	6

EVALUATION (DC-07)

a. Given the Ohm's law formula and a set of problems involving fractions, decimals, positive and negative numbers and exponents, the student will correctly calculate the missing values.

b. Test and review questions can be found in:
   1. Singer, Basic Mathematics for Electricity and Electronics, Chapters 2 and 3.
   2. MAVCC, Basic Electronics 1, Unit IX.
   3. Georgia, Electronics Technology, Phase A, Student Tests, Unit 15-A.
   4. Grob, Basic Electronics.

TASK

DC-08 Calculating voltage, current and resistance in DC series circuits

PERFORMANCE OBJECTIVE

Calculate voltage, current and resistance in DC series circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Voltage in series circuits
b. Current in series circuits
c. Resistance in series circuits
d. Using Ohm's law
    1. For part of a series circuit
    2. For total values in a series circuit
e. Control of current in series circuits
f. Formulas involving addition and subtraction
g. Use of the memory wheel for solving problems

Provide Practical Application On:

Locating faulty components in a series circuit using a voltmeter

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Basic Electronics 1
b. Singer, Basic Mathematics for Electricity and Electronics
c. Grob, Basic Electronics
d. Georgia, Electronics Technology, Phase A

Student Manuals:

a. Meade, Programmed Projects
b. Georgia, Electronics Technology, Phase A, Unit 18-A

Tools and Equipment:

a. Variable voltage power supply
b. Single-pole, single-throw switch
c. Two #47 bulbs
d. Voltmeter

LAB HOURS 6

CLASS HOURS 6

EVALUATION (DC-08)

a. Given a set of live DC series circuits with various combinations of voltage, resistors and amperage, the student will correctly calculate the unknown values of total voltage and voltage drops, resistance or amperage in each circuit and verify the calculations using a VOM.

b. Test and review questions can be found in:
   1. Singer, Basic Mathematics for Electricity and Electronics, Chapter 4.
   2. MAVCC, Basic Electronics 1.
   3. Georgia, Electronics Technology, Phase A, Student Tests, Unit 18-A.
   4. Grob, Basic Electronics.

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TASK

DC-09 Calculating total voltage, total current and total resistance

PERFORMANCE OBJECTIVE

Calculate the total voltage, total current and total resistance in DC parallel circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Total voltage in parallel circuits
b. Total current in parallel circuits
c. Total resistance in parallel circuits
d. Using Ohm's law
e. Division of current in a parallel circuit
f. Addition and subtraction of fractions
g. Fractions in formulas and equations
h. Opens and shorts in parallel circuits

Provide Demonstration On:

Calculating and measuring values in a parallel circuit

Provide Practical Application On:

Hooking up, measuring and analyzing parallel circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Basic Electronics 1
b. Singer, Basic Mathematics for Electricity and Electronics
c. Georgia, Electronics Technology, Phase A
d. Grob, Basic Electronics

Student Manuals:

a. Georgia, Electronics Technology, Phase A, Unit 19-A
b. Meade, Programmed Projects

Tools and Equipment:

a. Assorted resistors
b. Variable DC power supply
c. VOM

LAB HOURS 6
CLASS HOURS 6

EVALUATION (DC-09)

a. Given a live parallel resistive DC circuit containing resistors of different values, the student will accurately calculate and measure the voltage, current and resistance of parts of the circuit and for the total circuit using appropriate meters.

b. Test and review questions can be found in:
   1. MAVCC, Basic Electronics 1.
   2. Singer, Basic Mathematics for Electricity and Electronics, Chapter 5.
   3. Georgia, Electronics Technology, Phase A, Student Tests, Unit 19-A.
   4. Grob, Basic Electronics.

TASK

DC-10 Calculating and measuring electrical quantities in combination DC circuits

PERFORMANCE OBJECTIVE

Calculate and measure electrical quantities in combination DC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Combination circuits
b. Simplifying series-parallel circuits
c. Equivalent circuits
d. Voltage dividers
e. Grounds and voltage polarity
f. Opens and shorts
g. Schematic symbols

Provide Demonstration On:

a. Steps in simplifying a series parallel circuit
b. A voltage divider

Provide Practical Application On:

a. Measuring and calculating quantities in combination circuits
b. Constructing a voltage divider

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. MAVCC, Basic Electronics 1
c. Singer, Basic Mathematics for Electricity and Electronics
d. Georgia, Electronics Technology, Phase A

Student Manuals:

a. Georgia, Electronics Technology, Phase A, Unit 20-A
b. Meade, Programmed Projects

Tools and Equipment:

a. DC power supply
b. VOM
c. Two 1000, one 1500 and two 2200 ohm resistors, ½W
d. Switch, SPST
e. 12-v lamp or equivalent

LAB HOURS	6
CLASS HOURS	6

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EVALUATION (DC-10)

a. Using the components listed for this unit, the student will diagram a series parallel circuit, will calculate the total and branch quantities and will then construct the live circuit and measure the electrical quantities.

b. Test and review questions can be found in:
   1. Singer, Basic Mathematics for Electricity and Electronics, Chapter 6.
   2. Georgia, Electronics Technology, Phase A, Student Tests, Unit 20-A.
   3. Grob, Basic Electronics.
   4. Meade, Programmed Projects.

TASK

DC-11 Calculating power in DC circuits

PERFORMANCE OBJECTIVE

Calculate power in DC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Ohm's law
   1. Finding current
   2. Finding voltage
   3. Finding resistance
b. Power and wattage
   1. Work and power
   2. Current, voltage and power
   3. Power dissipation in resistors
   4. Total power in electric circuits
c. Equations derived from Ohm's law and the basic power formula
d. Finding the square root of a number

Provide Demonstration On:

a. Calculating power in a live circuit
b. Measuring electrical quantities in a live circuit and verifying Ohm's law

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Basic Electronics 1
b. Singer, Basic Mathematics for Electricity and Electronics
c. Heathkit, DC Electronics
d. Georgia, Electronics Technology, Phase A
e. Grob, Basic Electronics

Student Manuals:

a. Georgia, Electronics Technology, Phase A, Unit 16-A
b. Meade, Programmed Projects

Tools and Equipment:

a. ET-3100 Electronic Design Experimenter or equivalent
b. Volt-ohm-meter
c. 1000 ohm, 1% resistor
d. 100 ohm, 1% resistor

(Continued on back)

LAB HOURS	2
CLASS HOURS	4

EVALUATION (DC-11)

a. Given the equipment, components and test instruments listed in this unit, the student will diagram a simple DC circuit, construct the circuit, measure the electrical quantities and accurately calculate power in the circuit.

b. Test and review questions can be found in:
   1. Heathkit, DC Electronics, Unit 4.
   2. Georgia, Electronics Technology, Phase A, Student Tests, Unit 16-A.
   3. Meade, Programmed Projects.
   4. MAVCC, Basic Electronics I, Units VII and IX.
   5. Singer, Basic Mathematics for Electricity and Electronics, Chapter 7.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. 1200 ohm, 5% resistor, .5W
f. 22K ohm, 5% resistor, .5W
g. 33K ohm, 5% ½-watt resistor
h. 1K ohm, 5% ½-watt resistor
i. 2K ohm, 5% ½-watt resistor
j. 100K ohm potentiometer
   (built into ET-3100)

TASK

DC-12 Applying fundamentals of magnetism and electromagnetism

PERFORMANCE OBJECTIVE

Apply fundamentals of magnetism and electromagnetism.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The magnetic field
    1. Lines of force
    2. Theory of magnetism
b. Electricity and magnetism
    1. Current flow and magnetism
    2. The electromagnet
    3. Magnetic quantities
    4. Ohm's law for magnetic quantities
    5. Systems of measurement for magnetic quantities
c. Induction
    1. Magnetic induction
    2. Electromagnetic induction

(Continued on back)

Provide Demonstration On:

a. Illustration of the magnetic field using a magnet and iron filings
b. Examples of common applications of magnets and electromagnets

Provide Practical Application On:

Constructing and demonstrating the properties of an electromagnet

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Basic Electronics 1
b. Heathkit, DC Electronics
c. Georgia, Electronics Technology, Phase A
d. Grob, Basic Electronics

A/Vs:

Georgia, Electronics Technology, Phase A, "Basic Introduction to Magnetism," slide/tape 25-A

Student Manuals:

Georgia, Electronics Technology, Phase A, Unit 25-A

Tools and Equipment:

(Continued on back)

LAB HOURS 3
CLASS HOURS 3

EVALUATION (DC-12)

a. Given an assortment of magnetic and electromagnetic devices, the student will correctly identify by name, describe the function and application of each device and compute the ampere-turns magnetic strength of an electromagnet in a given circuit.

b. Test and review questions can be found in:
   1. Heathkit, DC Electronics, Unit 5.
   2. MAVCC, Basic Electronics 1, Unit XIII.
   3. Georgia, Electronics Technology, Phase A, Student Tests, Unit 25-A.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Applications of magnetism and electromagnetism
   1. AC generator
   2. DC generator
   3. Relay
   4. Reed switch and relay
   5. Record pickup
   6. Loudspeaker
   7. Magnetic tape
   8. DC motor
   9. Meter
   10. Computer memories
   11. Magnetic deflection of electron beams

e. The left-hand rule
   1. For coils
   2. For conductors

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. ET-3100 Electronic Design Experimenter or equivalent
b. Volt-ohm-meter
c. Compass
d. 100 ohm, 2-watt, 10% resistor
e. Slide switch
f. Hook-up wire
g. Permanent magnet
h. Magnetic reed switch
i. Relay
j. Incandescent lamp
k. Lamp socket
l. 1K ohm potentiometer (built into ET-3100)

TASK

DC-13 Analyzing and modifying meter movements

PERFORMANCE OBJECTIVE

Analyze and modify meter movements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. VOM meter movement
  1. Construction
  2. Operation
  3. Taut-band movement
b. The ammeter
  1. Increasing the range
  2. Computing shunt resistance
  3. Accuracy
c. The voltmeter
  1. Extending the range
  2. Calculating the multiplier
  3. Multiple-range voltmeters
  4. Sensitivity
  5. Loading effect

(Continued on back)

Provide Practical Application On:

a. Determining the sensitivity of a voltmeter
b. Loading effects of the voltmeter
c. Extending the current range of meters

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Electronics Technology, Phase A
b. Grob, Basic Electronics
c. Heathkit, DC Electronics
d. MAVCC, Basic Electronics 1

A/Vs:

(Continued on back)

Student Manuals:

a. Georgia, Electronics Technology, Phase A, Units 14-A and 22-A
b. Heathkit, DC Electronics
c. Meade, Programmed Projects

Tools and Equipment:

(Continued on back)

LAB HOURS 10

CLASS HOURS 4

EVALUATION (DC-13)

a. Given the tools and materials listed for this unit, the student will properly determine shunts to extend the range of ammeters, multipliers to extend the range of voltmeters and the necessary resistances to construct an ohmmeter using a basic current meter.

b. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Meade, Programmed Porjects.
   3. Georgia, Electronics Technology, Phase A, Units 14-A and 22-A.
   4. Heathkit, DC Electronics.
   5. MAVCC, Basic Electronics 1.

INSTRUCTIONAL MATERIALS

A/Vs:

a. Georgia, Electronics Technology, Phase A, "Proper Use and Care of Meters," slide/tape 14-A
b. Georgia, Electronics Technology, Phase A, "The Ayrton or Universal Meter Shunt," slide/tape 22-A

Tools and Equipment:

a. VOM
b. VTVM
c. Basic Electricity/Electronics Trainer
d. Variable voltage DC power supply
e. Variable voltage AC power supply
f. 10M ohm, ½-watt, 10% resistor
g. 100K ohm potentiometer
h. 100 ohm, ½-watt, 1% resistor
i. 220K ohm, ½-watt, 5% resistor
j. 1M ohm, ½-watt, 5% resistor
k. 10M ohm, ½-watt, 10% resistor
l. 1K ohm potentiometer

TASK

DC-14 Calculating values in DC network circuits

PERFORMANCE OBJECTIVE

Calculate values in DC network circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Simple circuits
b. Voltage dividers
c. Bridge circuits
    1. Balanced bridge
    2. Unbalanced bridge
    3. Applications of the bridge circuit
d. Kirchoff's law
    1. Kirchoff's voltage law
    2. Kirchoff's current law
e. Superposition theorem
f. Thevenin's theorem
g. Norton's theorem
h. Maximum power transfer theorem

Provide Practical Application On:

a. Bridge circuits
b. Maximum power transfer theorem
c. Series voltage dividers
d. Parallel current dividers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Georgia, Electronics Technology, Phase A
c. Heathkit, DC Electronics
d, MAVCC, Basic Electronics 1

Student Manuals:

a. Meade, Programmed Projects
b. Georgia, Electronics Technology, Phase A, Unit 21-A
c. Heathkit, DC Electronics

Tools and Equipment:

a. ET-3100 Electronic Design Experimenter or equivalent
b. Volt-oh-meter with test leads

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LAB HOURS 6

CLASS HOURS 4

EVALUATION (DC-14)

a. Given the tools and equipment listed for this unit, the student will diagram, construct and test the following circuits:
   1. A three resistor series voltage divider in which $E_{R1} = E_{R3}$, I_T = 5MA and E_{R2} = 60V.
   2. A three resistor parallel current divider in which I_{R3} is one-third of I_{R1} and R_2 is twice R_1.
   3. A balanced Wheatstone Bridge.

b. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Georgia, Electronics Technology, Phase A, Unit 21-A.
   3. Heathkit, DC Electronics.
   4. MAVCC, Basic Electronics 1.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. 470 ohm, ½-watt, 5% resistor
d. 68 ohm, ½-watt, 5% resistor
e. 1000 ohm, ½-watt, 1% resistor
f. 1000 ohm, ½-watt, 5% resistor
g. 100 ohm, ½-watt, 1% resistor
h. 100 ohm, ½-watt, 5% resistor
i. 200 ohm, ½-watt, 5% resistor
j. 68 ohm, ½-watt, 5% resistor
k. 10 ohm, ½-watt, 1% resistor
l. 22 ohm, ½-watt, 5% resistor
m. 10K ohm, ½-watt, 5% resistor
n. 2200 ohm, ¼-watt, 5% resistor
o. 4700 ohm, ½-watt, 5% resistor
p. 5100 ohm, ½-watt, 5% resistor
q. 100K ohm potentiometer (built into ET-3100)
r. Slide switch, DPDT

TASK

DC-15 Calculating capacitance and time constants for RC circuits

PERFORMANCE OBJECTIVE

Calculate capacitance and time constants for RC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Inductance
    1. Self-induction
    2. Inductors
    3. Schematic symbols for the inductor
    4. Time constant of an inductor
    5. Unit of inductance
b. Capacitance
    1. Unit of capacitance
    2. Factors determining capacitance
c. Capacitors
    1. Charging the capacitor
    2. Discharging the capacitor

(Continued on back)

Provide Demonstration On:

a. Types of inductors and capacitors
b. Mathematical applications for calculating inductance and capacitance in RC circuits

Provide Practical Application On:

Diagramming, constructing calculating parameters and measuring values in series and parallel RC circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Georgia, Electronics Technology, Phase A
c. Heathkit, DC Electronics
d. MAVCC, Basic Electronics 1

Student Manuals:

a. Meade, Programmed Projects
b. Georgia, Electronics Technology, Phase A, Unit 33-A
c. Heathkit, DC Electronics

Tools and Equipment:

a. ET-3100 Electronic Design Experimenter or equivalent
b. Volt-ohm-meter with test leads

(Continued on back)

LAB HOURS	4
CLASS HOURS	6

EVALUATION (DC-15)

a. Given the tools and equipment listed for this unit, the student will diagram and construct a series RC and a parallel RC circuit, will calculate the circuit parameters and will verify the calculations through measurement.

b. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Meade, Programmed Projects.
   3. MAVCC, Basic Electronics, Units V and VI.
   4. Georgia, Electronics Technology, Phase A, Unit 33-A.
   5. Heathkit, DC Electronics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   3. Types of capacitors
   4. Schematic symbol for the capacitor

d. RC time constants
e. Capacitors in combination
   1. In parallel
   2. In series
f. Mathematical applications
   1. Calculating total capacitance in networks
   2. Calculating RC time constants
   3. Solving time-constant problems

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. 50 microfarad 15 volt electrolytic capacitor
d. 500 microfarad 15 volt electrolytic capacitor
e. 100 ohm, ½-watt, 5% resistor
f. DPDT slide switch
g. Clock or watch with sweep-second hand
h. 100 K ohm potentiometer (built into ET-3100)
i. 10 microfarad electrolytic capacitor
j. 100 ohm, 2-watt, 10% resistor
k. Lamp socket
l. Lamp
m. Relay

TASK

AC-01 Calculating values for a right triangle

PERFORMANCE OBJECTIVE

Calculate values for a right triangle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Angles
b. Radians
c. Triangles
d. Right triangles
  1. Finding the acute angles
  2. Finding the sides
e. Trigonometric formulas
  1. Tangent of an angle
  2. Sine of an angle
  3. Cosine of an angle
f. Using the table of trigonometric functions

Provide Demonstration On:

Illustrating the properties of a right triangle

Provide Practical Application On:

Using trigonometric formulas

INSTRUCTIONAL MATERIALS

Textbooks:

Singer, Basic Mathematics for Electricity and Electronics

LAB HOURS	
CLASS HOURS	6

EVALUATION (AC-01)

a. Given a set of trigonometric problems and a table of trigonometric functions, the student will correctly solve for unknown values.

b. Test and review questions can be found in Singer, Basic Mathematics for Electricty and Electronics.

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TASK

AC-02 Using oscilloscopes

PERFORMANCE OBJECTIVE

Use oscilloscopes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. O-scope safety
b. O-scope preliminary control settings
c. O-scope hook-up to circuit
d. Scale interpretation

Provide Demonstration On:

a. How to use the scope manual to set-up vertical and horizontal controls
b. How to correctly connect and read the RMS voltage, P-P voltage, frequency and period of an AC signal

Provide Practical Application On:

Measuring voltage, frequency and time interval

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zbar, *Basic Electricity*
b. Gilmore, *Instruments and Measurements*
c. Heathkit, *Electronic Circuits*
d. Georgia, *Electronics Technology, Phase A*, Unit 28-A
e. MAVCC, *Basic Electronics 1*

A/Vs:

(Continued on back)

Tools and Equipment:

a. Oscilloscope
b. Manual for scope
c. Circuit to provide voltages and AC signals to measured

LAB HOURS	10
CLASS HOURS	2

EVALUATION (AC-02)

a. Given an oscilloscope and necessary circuits, the student will measure and record RMS values, the peak to peak amplitude, period and frequency of signals. Recordings must be within 10% of known values.

b. Heathkit, AC Electronics, Student Workbook.

c. MAVCC, Basic Electronics 1.

d. Georgia, Electronics Technology, Phase A, Student Tests.

e. Bergwall, filmstrip study questions.

INSTRUCTIONAL MATERIALS

A/Vs:

a. Georgia, Electronics Technology, Phase A, "Function and Use of the Oscilloscope," slide/tape 28-A
b. Bergwall, "Basic Electricity and Electronics Explained-AC," filmstrip 802-3, 802-4, 802-5

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TASK

AC-03 Analyzing AC sine waves

PERFORMANCE OBJECTIVE

Analyze AC sine waves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Difference between alternating current and direct current
b. Practical applications of alternating current
c. Generating alternating current
    1. Electromagnetic induction
    2. Simple alternating current generator
d. The sinusoidal wave form of AC voltage or current
    1. Frequency
    2. Period
    3. Wave length

(Continued on back)

Provide Demonstration On:

a. Use of the oscilloscope
b. Interpreting wave forms

Provide Practical Application On:

Using the oscilloscope to measure AC values

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, AC Electronics
b. MAVCC, Basic Electronics 1
c. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Introduction to Basic Oscilloscope Controls," slide/tape 28-A

Student Manuals:

Georgia, Electronics Technology, Phase A, Unit 28-A

Tools and Equipment:

a. Oscilloscope
b. Audio frequency generator
c. DC variable power supply
d. AC variable power supply
e. VOM
f. Graph paper

(Continued on back)

LAB HOURS	3
CLASS HOURS	3

EVALUATION (AC-03)

a. Given a sine wave display on the oscilloscope, the student will correctly determine the average, RMS, peak-to-peak, amplitudes, frequency and period of the wave form.

b. Test and review questions can be found in:
   1. MAVCC, Basic Electronics 1.
   2. Heathkit, AC Electronics.
   3. Georgia, Electronics Technology, Phase A, Unit 28-A.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

e. AC values
   1. Peak value
   2. Peak-to-peak value
   3. Average value
   4. Effective value
   5. Period
   6. Frequency

f. Nonsinusoidal wave forms
   1. The square wave
   2. The triangular wave
   3. The sawtooth wave
   4. Fluctuating DC waves

INSTRUCTIONAL MATERIALS

Tools and Equipment:

g. Compass
h. Protractor
i. Ruler
j. Calculator

TASK

AC-04 Measuring AC values for LF circuits

PERFORMANCE OBJECTIVE

Measure AC values for LF circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of AC meters
   1. Rectifier-type, moving coil meters
   2. Moving-vane meters
   3. Thermocouple meters
   4. Clamp-on meters
b. Using AC meters
c. Oscilloscopes
d. AC circuits containing only resistance
   1. Basic AC circuit calculations
   2. Series AC circuit calculations
   3. Parallel AC circuit calculations
   4. Power in AC circuits

Provide Demonstration On:

a. Types of AC meters
b. Proper operation of AC meters
c. Measuring voltage and current in an AC circuit

Provide Practical Application On:

a. Using test instruments to measure voltage and current in simple AC circuits
b. Making calculations in AC circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, AC Electronics
b. Training and Retraining, Inc., Basic Electricity/Electronics
c. Grob, Basic Electronics
d. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Important AC Units and Terms," slide/tape 26-A

Student Manuals:

a. Georgia, Electronics Technology, Phase A, Unit 26-A
b. Heathkit, AC Electronics

Tools and Equipment:

a. Experimenter or 15v, 60 Hz source
b. VOM
c. 470 ohm, ½-watt resistor
d. 1 K ohm, ½-watt resistor

(Continued on back)

LAB HOURS	2
CLASS HOURS	4

EVALUATION (AC-04)

a. Given a set of simple, series and parallel AC circuits containing only resistance, the student will correctly calculate electrical quantities and correctly measure voltage and current in the circuits using AC test meters.

b. Test and review questions can be found in:
   1. Heathkit, AC Electronics.
   2. Grob, Basic Electronics.
   3. Georgia, Electronics Technology, Phase A, Unit 26-A.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. Oscilloscope
f. Audio generator

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TASK

AC-05 Determining reactance and impedance of capacitors in series and parallel circuits

PERFORMANCE OBJECTIVE

Determine reactance and impedance of capacitor in series and parallel circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Structure and function of a capacitor
b. Capacitance
c. Capacitors in parallel
d. Capacitors in series
e. Reactance of a capacitor
f. Impedance of a capacitor
g. Measurement of capacitance
h. Capacitor types
i. Color code
j. Symbols
k. Charging and discharging

Provide Demonstration On:

a. Types of capacitors
b. Symbols
c. Charging and discharging

Provide Practical Application On:

a. Charging and discharging
b. Using a capacitor tester
c. Calculating reactance and impedance

INSTRUCTIONAL MATERIALS

Textbooks:

a. Singer, Basic Mathematics for Electricity and Electronics
b. Georgia, Electronics Technology, Phase A
c. Grob, Basic Electronics
d. Training and Retraining, Inc., Basic Electricity/Electronics
e. Duarte, Electronics Assembly and Fabrication Methods
f. Heathkit, AC Electronics

Student Manuals:

a. Meade, Programmed Projects
b. Georgia, Electronics Technology, Phase A, Unit 31-A
c. Heathkit, AC Electronics

Tools and Equipment:

Various types of capacitors

LAB HOURS 1

CLASS HOURS 5

EVALUATION (AC-05)

a. Given a set of diagrams of simple, series and parallel AC circuits containing capacitance, the student will correctly calculate impedance, reactance and capacitance.

b. Test and review questions can be found in:
   1. Singer, Basic Mathematics for Electricity.
   2. MAVCC, Basic Electronics 1.
   3. Grob, Basic Electronics.
   4. Georgia, Electronics Technology, Phase A, Unit 31-A.
   5. Heathkit, AC Electronics.

TASK

AC-06 Using capacitor testers

PERFORMANCE OBJECTIVE

Use capacitor testers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Capacitor tester safety
b. Capacitor tester hook-up to circuit or part
c. Capacitor tester preliminary control settings
d. Scale interpretation

Provide Demonstration On:

a. How to use the capacitor tester manual to correctly preset operation controls
b. How to correctly connect and read the capacitor tester scale to determine leakage and capacitance values

Provide Practical Application On:

Demonstrating the correct and safe way to set up, connect and read the results of using a capacitor tester to check capacitor parameters

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, DC Electronics
b. Georgia, Electronics Technology, Phase A
c. MAVCC, Basic Electronics 1

Student Manuals:

a. Heathkit, DC Electronics, Student Workbook
b. Georgia, Electronics Technology, Phase A, Units 31-A and 32-A

Tools and Equipment:

a. Capacitor tester manual
b. Capacitor tester
c. Capacitors to be checked
d. Capacitor specification manual

LAB HOURS	6
CLASS HOURS	

EVALUATION (AC-06)

a. Given a capacitor tester and ten capacitors of unknown condition, the student will demonstrate to the instructor the safe way to connect, setup, read and record the results of the measurements. The student must correctly identify the serviceable and defective capacitors.

b. Heathkit, DC Electronics, Student Workbook.

c. MAVCC, Basic Electronics 1.

d. Georgia, Electronics Technology, Phase A, Student Tests.

TASK

AC-07 Calculating and measuring electrical values in AC capacitance circuits

PERFORMANCE OBJECTIVE

Calculate and measure electrical values in AC capacitance circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Capacitors in AC circuits
   1. Current-voltage relationships
   2. Capacitive reactance
   3. Ohm's law in capacitance circuits
b. RC circuits
   1. Series RC circuits
   2. Impedance
   3. Phase shift
   4. Power in AC circuits
   5. Parallel RC circuits
c. Applications of capacitive circuits
   1. Capacitive voltage dividers
   2. Low-pass filter

(Continued on back)

Provide Practical Application On:

a. RC circuits
b. Capacitor applications
c. Calculating capacitive reactance in series and parallel circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, AC Electronics
b. MAVCC, Basic Electronics 1
c. Georgia, Basic Electronics Technology, Phase A

Student Manuals:

a. Meade, Programmed Projects

(Continued on back)

Tools and Equipment:

a. Experimenter or 30 VAC, 60 Hz source and sine wave signal generator
b. AC voltmeter
c. .001 microfarad capacitor
d. .039 microfarad capacitor
e. .1 microfarad capacitor
f. .47 microfarad capacitor
g. 4.7 K ohm, ½-watt resistor
h. 47 K ohm, ½-watt resistor

LAB HOURS	8
CLASS HOURS	4

EVALUATION (AC-07)

a. Given a set of diagrams for AC series and parallel capacitive circuits, the student will correctly calcualte the capacitive reactance in the circuits and determine the phase relationship between E and I.

b. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Meade, Programmed Projects.
   3. Heathkit, AC Electronics.
   4. Georgia, Electronics Technology, Phase A, Unit 32-A.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

1. Capacitive voltage dividers
2. Low-pass filter
3. High-pass filter
4. Decoupling network
5. Coupling network
6. Phase shift network

INSTRUCTIONAL MATERIALS

Student Manuals:

b. Georgia, Electronics Technology, Phase A, Unit 32-A
c. Heathkit, AC Electronics

TASK

AC-08 Using impedance testers

PERFORMANCE OBJECTIVE

Use impedance testers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Impedance tester control settings
c. Impedance tester hook-up procedures
d. Impedance tester readings

Provide Demonstration On:

a. How to use the impedance manual to set up the test control
b. How to correctly connect the impedance tester for circuit measurements
c. How to interpret meter readings

Provide Practical Application On:

Hooking up and setting up operator controls and read the impedance tester meter readings

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, AC Electronics
b. MAVCC, Basic Electronics 1

Student Manuals:

Heathkit, AC Electronics, Student Workbook

Tools and Equipment:

a. Manual
b. Impedance tester
c. Test circuit

LAB HOURS	10
CLASS HOURS	2

EVALUATION (AC-08)

Given an impedance tester, manual and test circuit with reactive components, the student will set up and measure unknown impedance values. All readings must be within 5% of actual values.

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TASK

AC-09 Measuring inductance in series and parallel RL circuits

PERFORMANCE OBJECTIVE

Measure inductance in series RL circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Inductor types and symbols
b. Inductors in AC circuits
    1. Current-voltage relationship
    2. Inductive reactance
    3. Ohm's law in inductive circuit
    4. Mutual inductance
    5. Inductors in series and in parallel
    6. Q
c. RL circuits
    1. Series RL circuits
    2. Impedance
    3. Phase shift
    4. Power
    5. Parallel RL circuits
d. Applications of inductive circuits

Provide Practical Application On:

a. Calculating inductance and inductive reactance in series and parallel RL circuits
b. Verifying calculations by measurement of electrical values in the circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, *AC Electronics*
b. MAVCC, *Basic Electronics 1*
c. Georgia, *Electronics Technology, Phase A*
d. Grob, *Basic Electronics*

Student Manuals:

a. Georgia, *Electronics Technology, Phase A*, Units 27-A, 29-A and 30-A
b. Meade, *Programmed Projects*
c. Heathkit, *AC Electronics*

Tools and Equipment:

a. AC voltmeter (Heathkit IM-17 or equivalent)
b. Experimenter or DC power supply, 30v 60 Hz source and sine wave
c. Signal generator
d. 4.5 henry Iron-core choke
e. 45 to 110mH Variable inductor
f. 2 1-kilohm, ½-watt resistors
g. Neon lamp
h. Alignment tool

LAB HOURS 6

CLASS HOURS 6

EVALUATION (AC-09)

a. Given a diagram of an inductive circuit, the student will draw a diagram illustrating the phase relationship between current and voltage.

b. Given a series RL circuit, the student will compute inductive reactance in ohms when the inductance in henrys and the frequency of operations are known.

c. Given a series RL circuit, the student will calculate the impedance of the circuit.

d. Given a parallel RL circuit, the student will calculate the impedance of the circuit.

e. Test and review questions can be found in:
   1. Heathkit, AC Electronics.
   2. MAVCC, AC Unit III.
   3. Meade, Programmed Projects.
   4. Grob, Basic Electronics.
   5. Georgia, Electronics Technology, Phase A, Units 27-A, 29-A and 30-A.

TASK

AC-10 Computing turns, voltage, current and impedance ratios of transformers

PERFORMANCE OBJECTIVE

Computing turns, voltage, current and impedance ratios of transformers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformer characteristics
    1. Mutual inductance
    2. Transformer action
    3. Transformer construction
    4. Symbols
b. Transformer theory
    1. Transformer with no load
    2. Transformer with load
c. Transformer ratios
    1. Voltage ratio
    2. Power ratio
    3. Current ratio
    4. Solving transformer problems

(Continued on back)

Provide Demonstration On:

Types of transformers

Provide Practical Application On:

a. The action of a transformer in an AC circuit
b. Solving problems of turns ratio, voltage ratio, current and impedance ratio

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, AC Electronics
b. Grob, Basic Electronics
c. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Transformer Impedance Ratio," slide/tape 37-A

Student Manuals:

a. Heathkit, AC Electronics
b. Georgia, Electronics Technology, Phase A, Unit 37-A

Tools and Equipment:

a. Experimenter or 15v 60 Hz source
b. Multimeter

(Continued on back)

LAB HOURS	
CLASS HOURS	12

EVALUATION (AC-10)

a. When supplied with diagrams of transformers, the student will correctly solve problems of turns ratio, voltage ratio, current ration and impedance ratio.

b. Test and review questions can be found in:
   a. Grob, Basic Electronics.
   b. Georgia, Electronics Technology, Phase A, Unit 37-A.
   c. Heathkit, AC Electronics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   5. Impedance ratio
d. Transformer losses
e. Transformer efficiency
f. Transformer applications
   1. Power distribution
   2. Electronic applications
   3. Autotransformer

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. 10 K ohm to 1740 ohm Audio Driver Transformer
d. 1000, ½-watt resistor
e. 100, ½-watt resistor
f. Filament transformer with HV windings

TASK

AC-11 Drawing phasor diagrams and calculating operating values for series AC circuits

PERFORMANCE OBJECTIVE

Draw phasor diagrams and calculate operating values for series AC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Phasors and phasor diagrams
b. Simple series AC circuits
    1. Containing only resistance
    2. Containing only inductance
    3. Containing only capacitance
c. The Pythagorean theorem
d. More complex series AC circuits
    1. Containing resistance and inductance
    2. Containing resistance and capacitance

(Continued on back)

Provide Demonstration On:

a. Measuring frequency and phase using the oscilloscope
b. Using the Time Measurement and Lissajous Pattern methods for measuring frequency

Provide Practical Application On:

a. Drawing phasor diagrams
b. Using the oscilloscope to measure frequency and phase angle

INSTRUCTIONAL MATERIALS

Textbooks:

a. Singer, *Basic Mathematics for Electricity and Electronics*
b. *Georgia, Electronics Technology, Phase A*

A/Vs:

Georgia, Electronics Technology, Phase A, "Measuring Frequency and Phase With a Scope," slide/tape 38-A

Student Manuals:

Georgia, *Electronics Technology, Phase A*, Unit 38-A

Tools and Equipment:

a. Dual trace oscilloscope
b. Two audio generators
c. Basic electronics trainer

LAB HOURS	3
CLASS HOURS	9

EVALUATION (AC-11)

a. Given series AC circuits and the proper tools and equipment, the student will draw phasor diagrams and calculate electrical values for the circuits.

b. Test and review questions can be found in:
   1. Singer, Basic Mathematics for Electricity and Electronics.
   2. Georgia, Electronics Technology, Phase A, Unit 38-A.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   3. Containing resistance, inductance and capcitance

e. Series resonance
   1. Finding the inductance to produce resonance
   2. Finding the capacitance to produce resonance

f. Values to be determined
   1. Current
   2. Total current
   3. Power
   4. Effective power
   5. Voltage
   6. Resistance
   7. Reactance
   8. Inductance
   9. Inductive reactance
   10. Impedance
   11. Phase angle
   12. Power factor
   13. Voltage drop
   14. Frequency
   15. Angle of lead
   16. Angle of lag
   17. Capacitance
   18. Resonant frequency

TASK

AC-12 Drawing phasor diagrams and calculating operating values for parallel AC circuits

PERFORMANCE OBJECTIVE

Draw phasor diagrams and calculate operating values for parallel AC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Simple parallel AC circuits
  1. Containing only resistance
  2. Containing only inductance
  3. Containing only capacitance
b. More complex parallel AC circuits
  1. Containing resistance and inductance
  2. Containing resistance and capacitance
c. Parallel resonance

(Continued on back)

Provide Demonstration On:

Using the oscilloscope and other test instruments to measure electrical values in AC parallel circuits

Provide Practical Application On:

a. Measuring electrical values in AC parallel circuits
b. Calculating values in AC parallel circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Singer, Basic Mathematics for Electricity and Electronics
b. Georgia, Electronics Technology, Phase A

A/Vs:

Georgia, Electronics Technology, Phase A, "Measuring Frequency and Phase With a Scope," slide/tape 38-A

Student Manuals:

Georgia, Electronics Technology, Phase A, Units 34-A and 38-A

Tools and Equipment:

a. Dual trace oscilloscope
b. Two audio generators
c. Basic electronics trainer
d. VOM

LAB HOURS	6
CLASS HOURS	6

EVALUATION (AC-12)

a. Given parallel AC circuits and the proper tools and equipment, the student will draw phasor diagrmas and calculate and measure electrical values for the circuits.

b. Test and review questions can be found in:
   1. Singer, Basic Mathematics for Electricty and Electronics.
   2. Georgia, Electronics Technology, Phase A, Units 34-A and 38-A.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

1. Finding the inductance to produce resonance
2. Finding the capacitance to produce resonance

d. Values to be determined for parallel AC circuits
   1. Current
   2. Total current
   3. Power
   4. Resistance
   5. Total resistance
   6. Reactance
   7. Inductance
   8. Impedance
   9. Total impedance
   10. Phase angle
   11. Power factor
   12. Capacitance
   13. Resonant frequency
   14. Series equivalent circuit
   15. In-phase current
   16. Reactive current

TASK

AC-13 Analyzing tuned AC circuits

PERFORMANCE OBJECTIVE

Analyze tuned AC circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. RLC circuits
   1. Series RLC circuits
   2. Parallel RLC circuits
b. Resonance
c. Series resonance
d. Q and bandwidth in series resonant circuits
e. LC filters
   1. Band-pass filter
   2. Band-stop filter
   3. Low-pass filter
   4. High-pass filter
g. Solving problems
   1. Calculating values for series and parallel

(Continued on back)

Provide Practical Application On:

a. Series resonance
b. Parallel resonance
c. LC filters and their response curves

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, AC Electronics
b. Grob, Basic Electronics
c. Georgia, Electronics Technology, Phase A

Student Manuals:

a. Georgia, Electronics Technology, Phase A, Units 35-A and 36-A
b. Heathkit, AC Electronics

Tools and Equipment:

a. Experimenter or sine wave signal generator and 100 K ohm potentiometer
b. Volt-ohmmeter
c. AC voltmeter
d. 107 mH coil
e. .001 microfarad ceramic capacitor
f. Two 4700 ohm, ½-watt resistors

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LAB HOURS 4

CLASS HOURS 3

EVALUATION (AC-13)

a. Given RLC circuits and the proper test instruments, the student will correctly calculate and measure electrical values.

b. Given LC circuits and the proper test instruments, the student will correctly calculate and measure resonant frequency, capacitance and inductance.

c. Test and review questions can be found in:
   1. Heathkit, AC Electronics.
   2. Georgia, Electronics Technology, Phase A, Unit 35-A.
   3. Meade, Programmed Projects.
   4. Grob, Basic Electronics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

2. Solving for resonant frequency, capacitance and inductance in LC circuits

INSTRUCTIONAL MATERIALS

Tools and Equipment:

g. Two 1000 ohm resistors
h. 10 K ohm, ½-watt resistor
i. .01 microfarad Mylar capacitor

TASK

SC-01 Analyzing the characteristics and functions of semiconductors

PERFORMANCE OBJECTIVE

Analyze the functions of semiconductors in electronic equipment and the electrical characteristics of semiconductor materials.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Common semiconductor devices
b. Function of semiconductors in electronic equipment
    1. Advantages of semiconductors compared to vacuum tubes
    2. Disadvantages of semiconductors compared to vacuum tubes
c. Electrical characteristics of semiconductor material
    1. Semiconductor atoms
    2. Semiconductor crystals
d. Conduction in intrinsic germanium and silicon

(Continued on back)

Provide Demonstration On:

Types of semiconductor materials and devices

Provide Practical Application On:

Identifying the types, characteristics and applications of various semiconductor devices

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B
c. Grob, Basic Electronics

Student Manuals:

Georgia, Electronics, Phase B, "Semiconductor Devices," slide/tape 1-B and "Semiconductor Materials," slide/tape 2-B

Student Manuals:

a. Georgia, Electronics, Phase B, Units 1-B and 2-B
b. Heathkit, Semiconductor Devices
c. Oleksy, Solid-State Electronics

Tools and Equipment:

a. Various types of semiconductor devices

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LAB HOURS 6

CLASS HOURS 6

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EVALUATION (SC-01)

a. Given various types of semiconductor devices, the student will identify each type, its characteristics and applications.

b. Given typical germanium and silicon diodes and the tools and equipment listed for this unit, the student will plot the V-I curves for the diodes.

c. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Heathkit, Semiconductor Devices.
   3. Georgia, Electronics, Phase B, Units 1-B and 2-B.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   1. Low temperature characteristics
   2. High temperature characteristics
   3. Holes
   4. Current flow

e. Conduction in doped germanium and silicon
   1. N-type semiconductors
   2. P-semiconductors

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Basic electricity/electronics experimenter
c. 1 silicon diode
d. 1 germanium diode
e. 1000 ohm, ½-watt resistor
f. 100 K ohm, ½-watt resistor
g. 1000 ohm potentiometer
h. VOM

TASK

SC-02 Analyzing the application and operation of semiconductor diodes

PERFORMANCE OBJECTIVE

Analyze the application and operation of semiconductor diodes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The PN junction
b. Diode biasing
  1. Forward bias
  2. Reverse bias
c. Diode characteristics
  1. Germanium diode
  2. Silicon diode
  3. Diode ratings
  4. Effect of temperature
  5. Diode symbols
d. Diode construction
  1. Diode construction
  2. Alloyed junctions
  3. Diffused junctions
  4. Diode packaging
e. Rectification and other applications

Provide Practical Application On:

a. Semiconductor diode characteristics
b. Testing semiconductor diodes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B
c. Zbar, Basic Electronics

Student Manuals:

a. Georgia, Electronics, Phase B, Unit 3-B
b. Heathkit, Semiconductor Devices
c. Oleksy, Solid-State Electronics
d. Zbar, Basic Electronics

Tools and Equipment:

a. Heathkit Electronic Design Experimenter ET-3100 or equivalent
b. Ohmmeter with test leads
c. Voltmeter with test leads
d. Silicon diode
e. Germanium diode
f. 1000 ohm ½-watt resistor
g. 100 ohm ½-watt resistor
h. 1000 ohm potentiometer

LAB HOURS 3

CLASS HOURS 3

EVALUATION (SC-02)

a. Given a germanium diode, a silicon diode and an ohmmeter, the student will test the condition of the diodes to determine if they are good or bad.

b. Test and review questions can be found in:
   1. Georgia, Electronics, Phase B, Unit 3-B.
   2. Heathkit, Semiconductor Devices.

TASK

SC-03 Analyzing the application and operation of zener diodes in regulator circuits

PERFORMANCE OBJECTIVE

Analyze the application and operation of zener diodes in regulator circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Zener diode characteristics
    1. Voltage-current characteristics
    2. Zener voltage
b. Power dissipation in zener diodes
    1. Power-temperature curves
    2. Derating factor
c. Current limitations in zener voltage
e. Temperature compensated zener diodes
f. Zener diode packages
g. Zener diode impedance

Provide Practical Application On:

a. The zener diode and its use as a voltage regulator
b. Constructing a zener diode regulator circuit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B
c. Zbar, Basic Electronics

Student Manuals:

a. Georgia, Electronics, Phase B
b. Heathkit, Semiconductor Devices
c. Zbar, Basic Electronics

Tools and Equipment:

a. Heathkit Electronic Design Experimenter ET-3100 or equivalent
b. Voltmeter with test leads
c. 47 ohm, ½-watt resistor
d. 100 ohm, ½-watt resistor
e. 220 ohm, ½-watt resistor
f. 470 ohm, ½-watt resistor
g. 1000 ohm, ½-watt resistor
h. 1N751 ±10%, 500 milliwatts
i. 1000 ohm potentiometer

LAB HOURS 8

CLASS HOURS 4

EVALUATION (SC-03)

a. Given the tools and equipment listed for this unit, the student will construct a zener diode regulator circuit incorporating a 1000 microfarad potentiometer and will measure and record diode voltage, diode current and output voltage at various resistance levels and range of output loads.

b. Test and review questions can be found in:
   1. Georgia, Electronics, Phase B, Unit 3-B.
   2. Heathkit, Semiconductor Devices.

TASK

SC-04 Analyzing the application and operation of tunnel, varator and high frequency diodes

PERFORMANCE OBJECTIVE

Analyze the application and operation of tunnel, varactor and high frequency diodes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The tunnel diode
   1. Voltage-current characteristics
   2. Negative resistance
   3. Construction and applications
   4. Tunnel diode symbols
b. The varactor diode
   1. Electrical characteristics
   2. Operating efficiency
   3. Construction and applications
   4. Varactor diode symbols
c. High frequency diodes
   1. PIN diodes
   2. IMPATT diodes
   3. Hot carrier diodes
   4. Gunn-effect diodes

Provide Demonstration On:

a. Samples of tunnel diodes, varactor diodes and high frequency diodes
b. Diode symbols

Provide Practical Application On:

a. Locating points on the V-I curve for tunnel diodes
b. Determining the quality factor (Q) for varactor diodes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B

Student Manuals:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B
c. Oleksy, Solid-State Electronics
d. Zbar, Basic Electronics

Tools and Equipment:

a. Basic electricity/electronics trainer
b. Variable voltage AC power supply
c. Tunnel, varactor and high frequency diodes
d. VOM

LAB HOURS	3
CLASS HOURS	3

EVALUATION (SC-04)

a. Given the tools and equipment listed for this unit, the student will locate the peak current, valley current, peak voltage and valley voltage points on a tunnel diode's V-I curve.

b. Given a selection of special purpose diodes, the student will identify each diode by name, electrical characteristics and application.

c. Test and review questions can be found in:
   1. Heathkit, Semiconductor Devices.
   2. Georgia, Electronics, Phase B.

TASK

SC-05 Analyzing the operation of bipolar transistors

PERFORMANCE OBJECTIVE

Analyze the operation of bipolar transistors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. PNP and NPN transistors and their symbols
b. Transistor construction and packaging
c. Basic transistor action
   1. Biasing NPN transistors
   2. Biasing PNP transistors
d. Transistor amplification
e. Transistor circuit arrangements
   1. Common base circuits
   2. Common emitter circuits
   3. Common collector circuits

(Continued on back)

Provide Demonstration On:

a. Types of bipolar transistors
b. Typical applications of bipolar transistors
c. Testing procedures

Provide Practical Application On:

a. Identifying types, characteristics and applications of bipolar transistors
b. Testing using an ohmmeter
c. Operating a transistor curve tracer
d. Operating a transistor tester

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B

Student Manuals:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B
c. Zbar, Basic Electronics
d. Oleksy, Solid-State Electronics

Tools and Equipment:

a. Ohmmeter with test leads
b. NPN silicon transistor MPSA20
c. PNP germanium transistor 2N2431
d. Various bipolar transistor
e. Transistor curve tracer
f. Transistor tester

LAB HOURS	12
CLASS HOURS	6

EVALUATION (SC-05)

a. When provided with various samples of bipolar transistors, the student will correctly identify each transistor by type, electrical characteristics and application.

b. Given the tools and equipment listed for this unit, the student will correctly test the transistors with an ohmmeter to determine if they are defective.

c. Given a transistor curve tracer, assorted transistors and data sheets for the transistors, the student will determine the beta for each transistor and compare the beta with the value published in the data sheets.

d. Test and review questions can be found in:
   1. Heathkit, Semiconductor Devices.
   2. Georgia, Electronics, Phase B, Units 5-B, 6-B, 7-B, 8-B and 9-B.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

f. Testing with an ohmmeter
g. Operating a transistor curve tracer
h. Operating a transistor tester
i. Testing bipolar transistors
   1. Test procedures
   2. Testing NPN transistors
   3. Testing PNP transistors
   4. Identifying a transistor
j. Determining alpha and alpha cutoff frequency
k. Determining beta and beta cutoff frequency

TASK

SC-06 Analyzing the operation of field effect transistors

PERFORMANCE OBJECTIVE

Analyze the operation of field effect transistors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The junction FET
  1. Construction
  2. Operation
  3. Gate-to-source cutoff voltage
  4. Pinch-off voltage
  5. Drain characteristic curves and transconductance
  6. Schematic symbols
b. The insulated gate FET
  1. Depletion-mode devices
  2. Enhancement-mode devices
  3. Safety precautions
c. FET circuit arrangements
  1. Common-square circuits
  2. Common-gate circuits
  3. Common-drain circuits

Provide Practical Application On:

a. Characteristics and operation of a junction FET
b. Characteristics and operation of an insulated gate FET

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B

Student Manuals:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics, Phase B, Unit 12-B
c. Oleksy, Solid-State Electronics

Tools and Equipment:

a. Heathkit Electronic Design Experimenter ET-3100 or equivalent
b. Voltmeter with test leads
c. N-channel insulated gate FET
d. 2-1000 ohm, ½-watt resistors
e. 4700 ohm, ½-watt resistor
f. 10 K ohm, ½-watt resistor
g. 100 K ohm potentiometer

(Continued on back)

LAB HOURS	3
CLASS HOURS	3

EVALUATION (SC-06)

a. Given the tools and equipment listed for this unit, the student will design and construct an FET circuit and calculate and measure its electrical characteristics.

b. Test and review questions can be found in:
   1. Heathkit, Semiconductor Devices.
   2. Georgia, Electronics, Phase B.
   3. Rutkowski, Solid-State Electronics.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. 1000 ohm potentiometer
i. N-channel junction FET
j. 100 ohm, ½-watt resistor

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TASK

SC-07 Analyzing the operation of thyristors

PERFORMANCE OBJECTIVE

Analyze the operation of thyristors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Silicon controlled rectifiers (SCR's)
  - 1. Construction and operation
  - 2. V-I characteristics
  - 3. Applications
- b. Bidirectional triode thyristors
  - 1. Construction and operation
  - 2. V-I characteristics
  - 3. Applications
- c. Unijunction transistors (UJT)
  - 1. Construction and operation
  - 2. V-I characteristics
  - 3. Applications
  - 4. Programmable UJT

Provide Practical Application On:

- a. Operation and an application of SCR
- b. Operation and an application of UJT

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Heathkit, *Semiconductor Devices*
- b. Georgia, *Electronics, Phase B*

Student Manuals:

- a. Heathkit, *Semiconductor Devices*
- b. Georgia, *Electronics, Phase B, Unit 12-B*
- c. *Oleksy, Solid-State Electronics*

Tools and Equipment:

- a. Heathkit Electronic Design Experimenter ET-3100 or equivalent
- b. Voltmeter with test leads
- c. Silicon controlled rectifier
- d. Germanium diode
- e. Silicon diode
- f. 220 ohm, ½-watt resistor
- g. 1000 ohm, ½-watt resistor

(Continued on back)

LAB HOURS 6

CLASS HOURS 6

EVALUATION (SC-07)

a. Given the tools and equipment listed for this unit, the student will design, construct and demonstrate the operation of an SCR in a half-wave phase control circuit.

b. Test and review questions can be found in:
   1. Georgia, Electronics, Phase B, Unit 12-B.
   2. Heathkit, Semiconductor Devices.
   3. Oleksy, Solid-State Electronics.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. 4700 ohm, ½-watt resistor
i. Lamp
j. 0.1 microfarad capacitor
k. 1000 ohm potentiometer
l. 100 k ohm potentiometer
m. Unijunction transistor
n. 47 ohm, ½-watt resistor
o. 100 ohm, ½-watt resistor
p. 10 k ohm, ½-watt resistor
q. 330 k ohm, ½-watt resistor
r. 10 microfarad electrolytic capacitor
s. 1000 ohm potentiometer

TASK

SC-08 Analyzing the operation of integrated circuits

PERFORMANCE OBJECTIVE

Analyze the operation of integrated circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Advantages and disadvantages of IC(s)
- b. Construction types
  - 1. Monolithic
  - 2. Bipolar
  - 3. MOS
  - 4. Thin-film
  - 5. Thick-film
  - 6. Hybrids
  - 7. Packages
- c. Applications
  - 1. Tri-state gate
  - 2. TTL open-collector gate
  - 3. Decade and up/down counters

(Continued on back)

Provide Demonstration On:

Examples of integrated circuits and their applications

Provide Practical Application On:

Constructing, operating and analyzing each type of IC application

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Heathkit, Semiconductor Devices
- b. Georgia, Electronics Technology, Integrated Circuits

Student Manuals:

- a. Heathkit, Semiconductor Devices
- b. Georgia, Electronics Technology, Integrated Circuits, Units IC-1 through IC-11

Tools and Equipment:

- a. IC breadboarding system
- b. Regulator - 7805

(Continued on back)

LAB HOURS	
CLASS HOURS	6

EVALUATION (SC-08)

a. Given the tools and equipment listed for this unit, the student will construct, operate and analyze each of the following applications of IC(s)
   1. Tri-state gate
   2. TTL open-collector gate
   3. Decade up/down counter
   4. Multiplexers and demultiplexers
   5. Seven segment indicator and decoder
   6. Optical coupler
   7. Operational amplifier
   8. IC timer
   9. Phase-locked loop
   10. Three terminal regulator

b. Test and review questions can be found in:
   1. Heathkit, Semiconductor Devices.
   2. Georgia, Electronics Technology, Integrated Circuits, Student Tests.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

4. Multiplexers and demultiplexers
5. Seven segment indicators and decoders
6. Optical couplers
7. MSI applications
8. Op-amps
9. IC timers
10. Phase-locked loops
11. Three terminal regulators
12. Linear IC applications

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. Potentiometer or rheostat 2.5K, 25 W
d. Oscilloscope - dual trace with DC mode
e. Sine wave generator - 0-1000 kHz with 0-10V pk-to-pk capability
f. Resistor - 4.7K ohm, 620 ohm, 3.9K, 6.8K, 1K, 100K, 10K, 300-400 ohm, 50 ohm, 1.2K, 5K, 10K, 220 ohm
g. Capacitors - 0.001 uF; 0.0047 uF; 0.1 uF; 10 uF; 0.003 uF
h. Power supply - variable voltage DC
i. Resistance decade box
j. Integrated circuit - 555
k. Miniature lamp - 8 volt
l. Diode - ECG 109
m. Switches - (2) SPST
n. Integrated circuit - uA 741; 565; 7404; 7493; 74150; 74154; 74193; 7490A; 7400; (2) 74126; (2) 7490
o. Data sheet - for uA 741 op-amp chip
p. VOM or multimeter
q. Optical coupler-motorola 4N30
r. Diode - 1N661
s. SCR - GE C20D
t. Transformer - 12.6V filament type
u. Digital clock
v. BCD to decimal decoder - 7447

(Continued on back)

(SC-08)

INSTRUCTIONAL MATERIALS

Tools and Equipment:

w. Program switches
x. State indicator lights - 6
y. Clock-for 5 volt system with both manual and low frequency capability
z. LED - 1.6V; 20 mA
aa. Interconnecting leads
bb. Function generator
cc. Hand tools - Wirestripper and long-nosed pliers

TASK

SC-09 Analyzing the operation of optoelectronic devices

PERFORMANCE OBJECTIVE

Analyze the operation of optoelectronic devices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Characteristics of light
b. Systems of light measurement
    1. Radiometric
    2. Photometric
c. Light sensitive devices
    1. Photoconductive cells
    2. Photovoltaic cells
    3. Photodiodes
    4. Phototransistors
d. Light emitting devices
    1. Operation and construction
    2. Electrical characteristics
    3. Applications

Provide Practical Application On:

a. Operation of a phototransistor
b. Operation of an LED

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics Technology, Integrated Circuits

Student Manuals:

a. Heathkit, Semiconductor Devices
b. Georgia, Electronics Technology, Integrated Circuits

Tools and Equipment:

a. Heathkit Electronic Design Experimenter ET-3100 or equivalent
b. Volt-ohm meter with test leads
c. Phototransistor
d. Lamp
e. 10 k ohm, 1/2-watt
f. 1000 k ohm potentiometer (built into ET-3100)
g. LED
h. 1000 k ohm, 1/2-watt

LAB HOURS	4
CLASS HOURS	2

EVALUATION (SC-09)

a. Given the tools and equipment listed for this unit, the student will demonstrate the operation of
   1. A phototransistor.
   2. A light-emitting diode.

b. Test and review questions can be found in:
   1. Heathkit, Semiconductor Devices.
   2. Georgia, Electronics Technology, Integrated Circuits, Student Tests.

TASK

VT-01 Analyzing the operation of diode vacuum tubes

PERFORMANCE OBJECTIVE

Analyze the operation of diode vacuum tubes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Construction of diode vacuum tubes
b. Thermionic emission
c. Cathode construction
d. Filament current
e. The vacuum
f. Diode rectifier circuits
    1. Load resistance
    2. Half-wave rectifier
    3. Ripple frequency
    4. DC polarity
    5. The diode as a one-way switch
g. Schematic symbol

Provide Demonstration On:

a. Various types of diode vacuum tubes
b. Diode vacuum tube applications

Provide Practical Application On:

Operation and dynamic characteristics of diode vacuum tubes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Manufacturer's tube manual
c. Georgia, Electronics, Phase B
d. Training and Retraining, Inc., Basic Electricity/Electronics

Student Manuals:

Georgia, Electronics, Phase B, Unit 13-B

Tools and Equipment:

a. Variable power supply panel
b. Vacuum tube characteristics panel
c. Multimeter
d. Oscilloscope
e. Linear graph paper
f. 100,000 ohm, 1-watt resistor
g. 22,000 ohm, 1-watt resistor

(Continued on back)

LAB HOURS 2

CLASS HOURS 2

EVALUATION (VT-01)

a. Given the tools and equipment listed for this unit, the student will demonstrate the operation and operational characteristics of diode vacuum tubes.

b. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Georgia, Electronics, Phase B, Unit 13-B.
   3. Training and Retraining, Inc., Basic Electricity/ Electronics.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. Vacuum tube, type 6AL5
i. Diode schematic overlay

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TASK

VT-02 Analyzing the operation of triode vacuum tubes

PERFORMANCE OBJECTIVE

Analyze the operation of triode vacuum tubes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Triode construction
b. C-voltage
c. Grid cutoff voltage
d. Triode circuit
e. Control-grid bias
f. Symbols for tube voltages
g. How a triode amplifies the control grid voltage
    1. Phase inversion
    2. Voltage gain
h. Triode characteristic values of grid voltage
i. Tube parameters
    1. Amplification factor
    2. Plate resistance
    3. Transconductance

(Continued on back)

Provide Demonstration On:

a. Various types of triode vacuum tubes
b. Triode vacuum tube application

Provide Practical Application On:

a. Static characteristics of triode vacuum tubes
b. Producing triode vacuum tube bias
c. The triode vacuum tube as an amplifier

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Manufacturer's tube manual
c. Georgia, Electronics, Phase B
d. Training and Retraining, Inc., Basic Electricity/Electronics

Student Manuals:

Georgia, Electronics, Phase B, Units 13-B and 14-B

Tools and Equipment:

a. Typical triode static characteristics curves
b. Linear graph paper
c. Variable power supply panel
d. Vacuum tube characteristics panel
e. Vacuum tube, type 6F5
f. Triode schematic overlay
g. Vacuum-tube voltmeter

(Continued on back)

LAB HOURS ☐

CLASS HOURS ☐

EVALUATION (VT-02)

a. Given the tools and equipment listed for this unit, the student will demonstrate the operation and operational characteristics of triode vacuum tubes.

b. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Georgia, Electronics, Phase B, Units 13-B and 14-B.
   3. Training and Retraining, Inc., Basic Electricity/Electronics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Tube manuals
k. Biasing
l. Interelectrode capacitance
m. Feedback voltage

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. Audio-frequency signal generator
i. Oscilloscope
j. 1 megohm, 1-watt resistor
k. 470,000 ohm, 1-watt resistor
l. 5100 ohm, 7-watt resistor
m. 1000 ohm, 1-watt resistor
n. .1 microfarad capacitor
o. .2 microfarad capacitor
p. 47,000 ohm, 1-watt resistor
q. 2200 ohm, 1-watt resistor

TASK

VT-03 Analyzing the operation of tetrode vacuum tubes

PERFORMANCE OBJECTIVE

Analyze the operation of tetrode vaccum tubes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tetrode tube construction
    1. Feedback reduction
    2. The screen grid
b. Screen grid voltage
c. Screen bypass capacitor
d. Grid plate capacitance
e. Secondary emission

Provide Demonstration On:

a. Types of tetrode vacuum tubes
b. Tetrode vacuum tube applications

Provide Practical Application On:

Operation and static characteristics of tetrode vacuum tubes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Manufacturer's tube manual
c. Training and Retraining, Inc., Basic Electricity/Electronics

Tools and Equipment:

a. Variable power supply panel
b. Vacuum tube characteristics panel
c. Linear graph paper
d. Vacuum tube, type 6SJ7
e. 1000 ohm, 5-watt resistor
f. 27 ohm, 1-watt resistor
g. Vacuum-tube voltmeter

LAB HOURS 2

CLASS HOURS 2

EVALUATION (VT-03)

a. Given the tools and equipment listed for this unit, the student will demonstrate the operation and operational characteristics of tetrode vacuum tubes.

b. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Training and Retraining, Inc., Basic Electricity/Electronics.

TASK

VT-04 Analyzing the operation of pentode vacuum tubes

PERFORMANCE OBJECTIVE

Analyze the operation of pentode vacuum tubes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pentode tube construction
b. Pentode vacuum tube characteristics
c. Current paths
d. Remote cutoff pentodes
e. High frequency operation
f. Secondary emission
g. Suppressor grid

Provide Demonstration On:

a. Types of pentode tubes
b. Pentode tube application

Provide Practical Application On:

Operation and static characteristics of a pentode vacuum tube

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Manufacturer's tube manual
c. Training and Retraining, Inc., Basic Electricity/Electronics

Tools and Equipment:

a. Variable power supply panel
b. Vacuum tube characteristics panel
c. Linear graph paper
d. Vacuum tube, type 6SJ7
e. 1000 ohm, 5-watt resistor
f. 27 ohm, 1-watt resistor

LAB HOURS	2
CLASS HOURS	2

EVALUATION (VT-04)

a. Given the tools and equipment listed for this unit, the student will demonstrate the operation and operational characteristics of pentode vacuum tubes.

b. Test and review questions can be found in:
   1. Grob, Basic Electronics.
   2. Training and Retraining, Inc., Basic Electricity/Electronics.

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TASK

VT-05 Inspecting and replacing vacuum tubes

PERFORMANCE OBJECTIVE

Inspect and replace vacuum tubes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Removal and installation of vacuum tubes
b. Operation of tube testers
c. Procedures for testing a specific vacuum tube
d. Control of defective tubes (methods of discarding which observe environmental protection requirements)
e. Signal tracing and condition testing

Provide Demonstration On:

a. Signal tracing with oscilloscope
b. Measuring tube voltages with the EVM
c. Removing and inspecting tubes
d. Testing tube or tube tester
e. Procedures for control of defective tubes

Provide Practical Application On:

a. Tracing signal with the oscilloscope

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Equipment service manual
b. Tube manuals
c. Applicable legal restrictions
d. Parts catalogs
e. Tube tester operation manual

Tools and Equipment:

a. Tube
b. Screwdrivers
c. Pliers
d. Wrenches
e. Tube tester
f. EVM
g. Oscilloscope
h. X1 probe
i. X10 probe

LAB HOURS	10
CLASS HOURS	

EVALUATION (VT-05)

a. Given equipment, tools, supplies and test instruments, the student will correctly locate a defective tube and replace it. Voltage tests and wave form analysis will be used to determine defective tube and verify normal operation after tube is replaced.

b. V'TECS, Electronics Mechanics, Task No. F-45.

c. V'TECS, Radio-Television, Task No. 26.

d. V'TECS, Radio Communications Technician, Task No. 37.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

b. Using EVM to measure voltage
c. Removing and inspecting tubes
d. Testing tubes

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TASK

EC-01 Analyzing common-emitter amplifier circuits

PERFORMANCE OBJECTIVE

Analyze common-emitter amplifier circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Functions and types of amplifiers
b. Amplifier configurations
    1. Common-emitter circuits
    2. Common-base circuits
    3. Common-collector circuits
c. Amplifier biasing
    1. Base-biased circuits
    2. Feedback bias
    3. Voltage-divider biasing
    4. Class of operation
d. Amplifier coupling
    1. Resistance-capacitance coupling

(Continued on back)

Provide Demonstration On:

a. Thermal stability of basic amplifier circuits
b. Operation and characteristics of a common-emitter amplifier circuit

Provide Practical Application On:

Having the learner construct
a. A basic amplifier circuit and demonstrate the relative thermal stability
b. A common-emitter amplifier and determine
    1. Voltage gain with and without a bypass capacitor

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Electronic Circuits
b. Grob, Basic Electronics
c. Shrader, Electronic Communications

Student Manuals:

a. Heathkit, Electonic Circuits, Student Workbook
b. Georgia, Electronics, Phase B

Tools and Equipment:

a. Heathkit Electronic Design Experimenter (ET-3100 or equivalent)
b. Voltmeter
c. NPN transistor

LAB HOURS 9

CLASS HOURS 3

EVALUATION (EC-01)

a. Given the tools and equipment listed for this unit, the student will construct a common-emitter amplifier circuit and will determine the thermal stability and operational parameters of the circuit. Test results must be within specifications established by the instructor.

b. Test and review questions can be found in:
   1. Heathkit, Electronic Circuits, Student Workbook.
   2. Georgia, Electronics, Phase B.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

2. Impedance coupling
3. Direct coupling
4. Transformer coupling

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. 2.2 kilohm, 1/2-watt resistor
e. 4.7 kilohm, 1/2-watt resistor
f. Two 10 kilohm, 1/2-watt resistor
g. 22 kilohm, 1/2-watt resistor
h. 470 kilohm, 1/2-watt resistor
i. 1.5 megohm potentiometer
j. Multimeter with leads
k. Oscilloscope
l. 1 kilohm, 1/2-watt resistor
m. 56 kilohm, 1/2-watt resistor
n. Three 33 microfarad tantalum capacitors
o. 1 kilohm potentiometer (built into ET-3100)
p. 100 kilohm potentiometer (built into ET-3100)

TASK

EC-02 Analyzing the operation of DC and audio amplifiers

PERFORMANCE OBJECTIVE

Analyze the operation of DC and audio amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Direct current amplifiers
    1. Multiple-stage amplifiers
    2. Darlington amplifiers
    3. Differential amplifiers
b. Audio amplifiers
    1. Voltage amplifiers
    2. Power amplifiers
    3. Single-ended power amplifiers
    4. Push-pull power amplifiers
    5. Complementary amplifiers

(Continued on back)

Provide Demonstration On:

a. The DC amplifier
b. Distortion in a complementary power amplifier

Provide Practical Application On:

Condition testing of DC and audio amplifiers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Electronic Circuits
b. Grob, Basic Electronics
c. Shrader, Electronic Communications

Student Manuals:

a. Heathkit, Electronic Circuits, Student Workbook
b. Georgia, Electronics, Phase B

Tools and Equipment:

a. Heathkit Experimenter (ET-3100 or equivalent)
b. Multimeter with leads
c. Calibrated oscilloscope with leads

(Continued on back)

LAB HOURS 10

CLASS HOURS 2

EVALUATION (EC-02)

a. Given the tools and equipment listed for this task, the student will construct and analyze a DC amplifier.

b. Given the tools and equipment listed for this task, the student will construct and analyze a power amplifier.

c. Test and review questions can be found in:
   1. Heathkit, Electronic Circuits, Student Workbook, Unit 2.
   2. Georgia, Electronics, Phase B.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   6. Quasi-complementary amplifiers
   7. Heat sinks
   8. Volume control circuits
   9. Tone control circuits

c. RF amplifiers

d. IF amplifiers

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. 4.7 ohm, 1/2-watt resistor

e. Two 100 ohm, 1/2-watt resistors

f. Two 330 ohm, 1/2-watt resistors

g. 4700 ohm, 1/2-watt resistor

h. 8200 ohm, 1/2-watt resistor

i. 10 kilohm, 1/2-watt resistor

j. 47 kilohm, 1/2-watt resistor

k. 10 microfarad tantalum capacitor

l. 33 microfarad electrolytic capacitor

m. 250 microfarad electrolytic capacitor

n. 100 microfarad electrolytic capacitor

o. 0.1 microfarad Mylar

p. Stabistor

q. Two NPN transistors

r. PNP transistor

s. Loudspeaker

t. One kilohm potentiometer (built into ET-3100)

u. One kilohm potentiometer (built into ET-3100)

v. Two 1000 ohm, 1/2-watt resistors

w. 100 kilohm, 1/2-watt resistor

x. 100 pF capacitor

y. 1000 pF (.001 microfarad) capacitor

z. Silicon diode

aa. Darlington transistor

TASK

EC-03 Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers

PERFORMANCE OBJECTIVE

Analyze the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Differential amplifiers
   1. Basic differential amplifiers circuits
   2. Single-input, single output operation
   3. Single-input, differential-output circuit
   4. Differential-input, differential-output operation
5. Current sources and voltage sources
6. Practical current
7. Practical differential amplifiers

(Continued on back)

Provide Demonstration On:

Operational amplifiers

Provide Practical Application On:

Determining:
a. Characteristics of differential amplifiers
b. Characteristics of the operational amplifier and its use as a comparator
c. Characteristics of inverting and noninverting amplifiers
d. Characteristics of active filters

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Electronic Circuits
b. Grob, Basic Electronics
c. Schrader, Electronic Communication

Student Manuals:

a. Heathkit, Electronic Circuits, Student Workbook
b. Georgia, Electronics, Phase B

Tools and Equipment:

a. Heathkit Experimenter (ET-3100 or equivalent)
b. Multimeter with leads
c. Oscilloscope with probe

(Continued on back)

LAB HOURS 18

CLASS HOURS 6

EVALUATION (EC-03)

a. Given the tools and equipment listed for this unit, the student will construct and analyze the operation of a differential amplifier, an operational amplifier used as a comparator, an inverting amplifier and a noninverting amplifier

b. Test and review questions can be found in:
   1. Heathkit, Electronic Circuits, Student Workbook, Unit 2.
   2. Georgia, Electronics, Phase B.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

8. Common-mode input operation
9. Differential-input operation
10. Common-mode rejection ratio
11. Integrated circuit differential amplifiers

b. Operational amplifier characteristics
c. LC operational amplifier families
d. Closed-loop operation
   1. Inverting configuration
   2. Noninverting configuration
   3. Bandwidth limitations
   4. Operational amplifier circuits
e. Applications of operational amplifiers
   1. Summing amplifier (adder)
   2. Active filters
   3. Difference amplifiers

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. 100 k ohm, potentiometer
e. 10 ohm, 1/2-watt resistor
f. Three NPN transistors
g. Two 4.7 k ohm, 1/2-watt resistors
h. Two 10 k ohm, 1/2-watt resistors
i. 2.2 k ohm, 1/2-watt resistor
j. 33 k ohm, 1/2-watt resistor
k. 47 k ohm, 1/2-watt resistor
l. Three 1 k ohm, 1/2-watt resistors
m. Two 100 ohm, 1/2-watt resistors
n. 200 ohm, potentiometer
o. Audio transformer
p. 10 microfarad electrolytic capacitor
q. 1 k ohm potentiometer (built into ET-3100)
r. Hook-up wire
s. Soldering iron
t. 741 C operational amplifier
u. Two 100 k ohm, 1/2-watt resistors
v. Three 0.0022 microfarad capacitors
w. 8.2 k ohm, 1/2-watt resistors

TASK

EC-04 Testing amplifiers for amplification

PERFORMANCE OBJECTIVE

Test and determine the amplification gain of an amplifier.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Amplifier operation and theory
b. Test equipment hookup for testing
c. Gain measurement testing
d. DB

Provide Demonstration On:

a. How to set up an amplifier to perform gain tests
b. How to collect data from gain tests
c. How to plot an amplifier amplitude-to-frequency gain characteristic

Provide Practical Application On:

a. Practicing testing amplifiers for gain characteristics and collecting data that can be used to plot the amplifiers gain parameters
b. Plotting the gain characteristics of the amplifiers

INSTRUCTIONAL MATERIALS

Textbooks:

Wells, Audio Servicing: Theory and Practice

Student Manuals:

a. Wells, Audio Servicing: A Text-Lab Manual
b. Georgia, Electronics, Phase B

Tools and Equipment:

a. Amplifiers
b. Voltmeter
c. Oscilloscope
d. Audio meter
e. Graph paper

LAB HOURS	3
CLASS HOURS	3

EVALUATION (EC-04)

a. Given an amplifier and the necessary supplies and equipment, the student will test, collect data and plot the gain of the amplifier. The data must be plotted on graph paper so that an overall picture of the characteristics (amplitude to frequency response) can be seen. The characteristics must be within the operational parameters of the amplifier.

b. Given a problem involving gain of an amplifier, the student will correctly state the gain in DB and will be able to state the gain or loss factor (2X, 4X, etc.) for common values of power and voltage ratios such as 3 DB, 6 DB, 10 DB and 100 DB.

TASK

EC-05 Testing and repairing vacuum tube amplifiers

PERFORMANCE OBJECTIVE

Test and repair vacuum tube amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Normal operating procedure of the vacuum tube amplifier
b. Troubleshooting steps
c. Standard repair procedures

Provide Demonstration On:

a. Testing the amplifier for normal performance
b. Some abnormal operating conditions of the amplifier
c. The standard method to troubleshoot the amplifier

Provide Practical Application On:

Having learner to
a. Practice checking out vacuum tube amplifiers for normal operation
b. Demonstrate how to correct malfunctions in the vacuum tube amplifier

INSTRUCTIONAL MATERIALS

Student Manuals:

Prentice-Hall, Troubleshooting: A Self-Instructional Programmed Manual

Tools and Equipment:

a. Vacuum tube amplifier
b. Test equipment
c. Schematic and manual
d. Screwdrivers, blade, assorted
e. Screwdrivers, Phillips head, assorted
f. Wrenches, adjustable
g. Iron, soldering
h. Solder, resin core
i. Pliers, needle nose
j. Pliers, diagonal
k. Flashlight

LAB HOURS 4

CLASS HOURS 2

EVALUATION (EC-05)

Given a vacuum tube amplifier, the schematic and the necessary tools and test equipment, the student will test the amplifier for normal and abnormal operation. Malfunctions must be corrected so that the amplifier performs to the standards of the specification manual.

TASK

EC-06 Testing and repairing transistor amplifiers

PERFORMANCE OBJECTIVE

Test and repair transistor amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Normal operating conditions of the transistor amplifier
b. Troubleshooting a standard transistor amplifier
c. Basic repair procedures

Provide Demonstration On:

a. Testing the transistor amplifier for normal operation
b. Some abnormal operating conditions of a transistor amplifier
c. Standard method to troubleshoot the amplifier

Provide Practical Application On:

a. Practicing checking out the operation of some transistor amplifiers
b. Demonstrating how to troubleshoot the amplifier for different types of malfunctions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Lenk, Handbook of Practical Solid State Troubleshooting
b. Lenk, Handbook of Modern Solid State Amplifiers

Student Manuals:

Prentice-Hall, Electronic Troubleshooting: A Self-Instructional Programmed Manual

Tools and Equipment:

a. Transistor amplifier
b. Test equipment
c. Schematic and manual
d. Screwdrivers, blade, assorted

(Continued on back)

LAB HOURS 4

CLASS HOURS 2

EVALUATION (EC-06)

Given a transistor amplifier, the schematic and the necessary tools and test equipment, the student will test the amplifier for normal and abnormal operation. Malfunctions must be corrected so that the amplifier performs to the standards of the specification manual.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. Screwdrivers, Phillips head, assorted
f. Wrenches, adjustable
g. Iron, soldering
h. Solder, resin core
i. Pliers, needle nose
j. Pliers, diagonal
k. Flashlight

TASK

EC-07 Analyzing power supply circuits

PERFORMANCE OBJECTIVE

Analyze power supply circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Rectifier circuits
  - 1. Half-wave rectifiers
  - 2. Full-wave rectifiers
  - 3. Bridge rectifiers
- b. Power supply filters
  - 1. The capacitor as a filter
  - 2. Percent ripple
  - 3. RC filters
  - 4. LC filters
- c. Voltage multipliers
  - 1. Half-wave voltage double
  - 2. Full-wave voltage double
  - 3. Voltage tripler
    - 1. Load regulation

(Continued on back)

Provide Demonstration On:

- a. Unregulated power supplies
- b. Operation and characteristics of the shunt regulator and the series regulator

Provide Practical Application On:

- a. Constructing a power supply circuit using a kit
- b. Identifying the component parts and electrical characteristics of the power supply circuit

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Heathkit, Electronic Circuits
- b. Grob, Basic Electronics

Student Manuals:

- a. Heathkit, Electronic Circuits, Student Workbook
- b. Georgia, Electronics, Phase B

Tools and Equipment:

- a. Heathkit Experimenter (ET-3100 or equivalent)
- b. Oscilloscope with leads
- c. Voltmeter with leads
- d. Silicon diodes

(Continued on back)

LAB HOURS	8
CLASS HOURS	4

EVALUATION (EC-07)

a. Given the tools and equipment listed for this unit, the student will construct and analyze the operation of a power supply circuit.

b. Test and review questions can be found in:
  1. Heathkit, Electronic Circuits, Student Workbook.
  2. Georgia, Electronics, Phase B.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

  2. The zener regulator

d. Series voltage regulator
  1. The emitter follower regulator
  2. The feedback regulator
  3. The feedback regulator with operational amplifier
  4. Short circuit protection

e. Power supply circuits
  1. Overload protection devices
  2. Protective circuits
  3. Shunt regulators
  4. IC regulators
  5. Oscilloscope power supply
  6. Color TV power supply

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. 10 microfarad, 70 volt, electrolytic capacitor
f. 100 microfarad, 50 volt, electrolytic capacitor
g. 5600 ohm, 1/2-watt resistor
h. 22 k ohm, 1/2-watt resistor
i. Silicon transistor (417-818)
j. Three silicon transitors (417-801)
k. 2.7 V zener diode
l. 6.2 V zener diode
m. 721C operational amplifier
n. Two silicon diodes (57-27)
o. 10 ohm, 1/2-watt resistor
p. 100 ohm, 1/2-watt resistor
q. 150 ohm, 1/2-watt resistor
r. 220 ohm, 1/2-watt resistor
s. 330 ohm, 1/2-watt resistor
t. 620 ohm, 1/2-watt resistor
u. Three 1000 ohm, 1/2-watt resistors
v. 1800 ohm, 1/2-watt resistor
w. 47 k ohm, 1/2-watt resistor
x. One k ohm potentiometer (built into ET-3100)
y. 100 k ohm potentiometer (built into ET-3100)

TASK

EC-08 Testing and repairing power supplies

PERFORMANCE OBJECTIVE

Test and repair power supplies.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Standard operation of the power supply
b. Voltage specifications
c. Types of malfunctions
d. Types of test equipment to be used to locate trouble
e. Correcting malfunctions

Provide Demonstration On:

a. How to check the different voltages in the power supply
b. How the power supply electrically operates
c. The steps used to locate malfunctions in the power supply

Provide Practical Application On:

a. Operating a good power supply and check voltages of the normal power supply
b. Explaining how to troubleshoot the circuit if abnormal voltages exist

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

Student Manuals:

Prentice-Hall, Electronic Troubleshooting: A Self-Instructional Programmed Manual

Tools and Equipment:

a. Power supplies, good and bad
b. Oscilloscope
c. VTVM
d. Schematic
e. Operation manual
f. Screwdrivers, blade, assorted

(Continued on back)

LAB HOURS 4

CLASS HOURS 2

EVALUATION (EC-08)

Given a power supply, schematic and the necessary tools and equipment, the student will check a power supply for correct operation and correct any malfunction. Malfunctions must be corrected so that the power supply output conforms to the manufacturer's specifications.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

g. Screwdrivers, Phillips head, assorted
h. Wrenches, adjustable
i. Iron, soldering
j. Solder, resin core
k. Pliers, needle nose
l. Pliers, diagonal
m. Flashlight

TASK

EC-09 Calibrating power supply voltage

PERFORMANCE OBJECTIVE

Calibrate power supply voltage.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Normal calibration procedures
b. Troubleshooting steps
c. Troubleshooting-locating the area of trouble
d. Troubleshooting to the component level

Provide Demonstration On:

a. Normal calibration
b. Recognizing an abnormal power supply
c. Using visual, test, area isolation and component level techniques to troubleshoot

Provide Practical Application On:

a. Practicing calibrating some good power supplies
b. Calibrating power supplies with defective outputs
c. Writing a conclusion about the nature of the problems

INSTRUCTIONAL MATERIALS

Textbooks:

Lemons, Learn Electronics Through Troubleshooting

Student Manuals:

Prentice-Hall, Electronic Troubleshooting: A Self-Instructional Programmed Manual

Tools and Equipment:

a. Power supplies, good and bad
b. Oscilloscope
c. VTVM
d. Screwdrivers, blade, assorted
e. Screwdrivers, Phillips head, assorted
f. Wrenches, adjustable
g. Iron, soldering
h. Solder, resin core
i. Pliers, needle nose
j. Pliers, diagonal
k. flashlight

LAB HOURS 4
CLASS HOURS 2

EVALUATION (EC-09)

Given a power supply and the necessary tools and equipment, the student will calibrate the power supply and troubleshoot the power supply by using the calibration procedure. The power supply must be calibrated or, if not, the problem must be identified in writing.

TASK

EC-10 Analyzing the operation of oscillators

PERFORMANCE OBJECTIVE

Analyze the operation of oscillators.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Characteristics of a basic oscillator
b. Transformer oscillators
    1. Tuned-collector oscillators
    2. Tuned-base oscillators
c. LC oscillators
    1. The series-fed Hartley oscillator
    2. The shunt-fed Hartley oscillator
    3. Crystal Colpitts and Clapp oscillator
d. Controlled oscillators
    1. Equivalent crystal circuits

(Continued on back)

Provide Demonstration On:

a. The practical tank circuit
b. LC oscillators (Colpitts and Hartley)
c. Crystal oscillators (Colpitts and Pierce)
d. The Wien-bridge oscillator

Provide Practical Application On:

Having the learner construct an oscillator

INSTRUCTIONAL MATERIALS

Textbooks:

Heathkit, Electronic Circuits

Student Manuals:

a. Heathkit, Electronic Circuits
b. Georgia, Electronics, Phase C

Tools and Equipment:

a. Heath Experimenter (ET-3100 or equivalent
b. Oscilloscope with leads
c. VOM
d. 47 microhenry coil
e. NPN transistor

(Continued on back)

LAB HOURS	8
CLASS HOURS	4

EVALUATION (EC-10)

a. Given the tools and equipment listed for this task, the student will construct an oscillator and analyze its operation.

b. Test and review question can be found in:
   1. Heathkit, Electronic Circuits.
   2. Georgia, Electronics, Phase C.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   2. The Hartley Crystal oscillator
   3. The Colpitts Crystal oscillator
   4. The Pierce oscillator
   5. The Butler oscillator
e. RC oscillators
   1. The phase-shift oscillator
   2. The Wein-bridge oscillator
f. Nonsinusoidal oscillators
   1. The blocking oscillator
   2. A sawtooth blocking oscillator
g. High frequency oscillators

INSTRUCTIONAL MATERIALS

Tools and Equipment:

f. 3579.545 kilohertz crystal
g. 4.7 pF capacitor
h. 24 pF capacitor
i. 47 pF capacitor
j. Two .01 microfarad capacitors
k. Two .001 microfarad capacitors
l. 560 ohm, 1/2-watt resistor
m. 1500 ohm, 1/2-watt resistor
n. 8200 ohm, 1/2-watt resistor
o. Two 10 k ohm, 1/2-watt resistors
p. 47 k ohm, 1/2-watt resistor
q. Two 100 k ohm, 1/2-watt resistors
r. Two 1 M ohm, 1/2-watt resistors
s. 305 microhenry inductor
t. Two .1 microfarad capacitors
u. 22 k ohm, 1/2-watt resistor
v. 4.7 ohm, 1/2-watt resistor
w. Two 100 pF capacitors
x. 470 pF capacitor
y. 741 C operational amplifier
z. Incandescent lamp
aa. 220 ohm, 1/2 watt resistor
bb. 1 k ohm potentiometer
cc. 30-watt soldering iron

TASK

EC-11 Testing and repairing oscillators

PERFORMANCE OBJECTIVE

Test and repair oscillators.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Oscillator operation and theory
b. Types of oscillators
c. Methods of testing oscillators
d. Methods of calibration

Provide Demonstration On:

a. How the oscillator works
b. Some abnormal symptoms
c. Some common defects
d. Basic repair techniques

Provide Practical Application On:

a. Testing and calibrating several oscillator circuits
b. Troubleshooting and repairing defective oscillator circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Shrader, Electronic Communication
b. Horowitz and Hill, The Art of Electronics
c. Heathkit, Electronic Circuits

Student Manuals:

a. Heathkit, Electronic Circuits, Student Workbook
b. Georgia, Electronics, Phase C

Tools and Equipment:

a. Oscillator circuit
b. Oscilloscope
c. VOM
d. Schematic
e. Screwdrivers, blade, assorted

(Continued on back)

LAB HOURS	8
CLASS HOURS	4

EVALUATION (EC-11)

Given both good and defective oscillator circuits, schematics and the necessary tools and equipment, the student will identify the defective circuits and make the necessary repair(s). The repaired circuits must operate according to specifications.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

f. Screwdrivers, Phillips head, assorted
g. Wrenches, adjustable
h. Iron, soldering
i. Solder, resin core
j. Pliers, needle nose
k. Pliers, diagonal
l. Flashlight

TASK

EC-12 Testing and repairing counter circuits

PERFORMANCE OBJECTIVE

Test and repair counter circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Counter theory and operation
b. Troubleshooting the counter with test equipment
c. Basic repair techniques of the counter
d. How to use a digital probe

Provide Demonstration On:

a. How to test the counter circuit
b. Some abnormal operating conditions of the counter
c. How to troubleshoot and repair the counter

Provide Practical Application On:

Testing the counter circuits and identifying the defective circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Triebel, Integrated Digital Electronics
b. Tokheim, Digital Electronics
c. Heathkit, Digital Techniques

Tools and Equipment:

a. Counter circuit
b. Voltmeter
c. Digital probe
d. Oscilloscope
e. Schematic
f. Screwdrivers, blade, assorted
g. Screwdrivers, Phillips head, assorted
h. Wrenches, adjustable
i. Iron, soldering

(Continued on back)

LAB HOURS	8
CLASS HOURS	4

EVALUATION (EC-12)

Given a counter circuit, schematic and the necessary tools and equipment, the student will perform an operational check on the circuit and repair any malfunction(s). The repaired circuit must meet the specified standards of operation.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

j. Solder, resin core
k. Pliers, needle nose
l. Pliers, diagonal
m. Flashlight

TASK

EC-13 Analyzing pulse circuits

PERFORMANCE OBJECTIVE

Analyze pulse circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Nonsinusoidal wave forms
  - 1. Frequency domain analysis
  - 2. Wave form spectrum
- b. Wave shaping
  - 1. RC wave shaping by differentiator
  - 2. RC waveshaping by integrator
  - 3. Types of diode clipping circuits
  - 4. Transistor clippers
  - 5. Clampers
- c. Rectangular wave generators
  - 1. Astable multivibrator
  - 2. Monostable multivibrator

(Continued on back)

Provide Demonstration On:

- a. Wave shaping
- b. Operation and characteristics of various rectangular-wave generators
- c. Ramp generators

Provide Practical Application On:

Having the learner construct a pulse circuit and perform a condition test of the circuit

INSTRUCTIONAL MATERIALS

Textbooks:

Heathkit, Electronic Circuits

Student Manuals:

Heathkit, Electronic Circuits, Student Workbook

Tools and Equipment:

- a. Heathkit, Experimenter (ET-3100 or equivalent)
- b. Oscilloscope with leads
- c. Multimeter with leads
- d. Two NPN silicon transistors
- e. Two silicon diodes
- f. "555 Timer" IC
- g. 100 ohm 1/2-watt resistor
- h. Three 1000 ohm, 1/2-watt resistors
- i. 1500 ohm, 1/2-watt resistor

(Continued on back)

LAB HOURS 6

CLASS HOURS 6

EVALUATION (EC-13)

a. Given the necessary instructions, supplies and equipment, the student will construct a pulse circuit and analyze the operation of the circuit. The pulse circuit must operate according to specifications.

b. Test and review questions may be found in: Heathkit, Electronics Circuits, Student Workbook.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    3. Bistable multivibrator
    4. Schmitt trigger
    5. The 555 timer
d. Ramp generators
    1. Forming the ramp
    2. Operational amplifier
    3. Sawtooth generator

INSTRUCTIONAL MATERIALS

Tools and Equipment:

j. Two 3300 ohm, 1/2-watt resistors
k. Two 10 k ohm, 1/2-watt resistors
l. Two 0.1 microfarad capacitators
m. Two 0·01 microfarad capacitators
n. 0.001 microfarad capacitor
o. 0.039 microfarad capacitor
p. 0.02 microfarad capacitor
q. 100 k ohm potentiometer (built into ET-3100)
r. 4700 ohm, 1/2-watt resistor
s. 22 k ohm, 1/2-watt resistor
t. 1 Megohm, 1/2-watt resistor
u. Silicon transistor
v. Silicon diode
w. 2.7 V zener diode
x. 6.2 V zener diode
y. 741 C operational amplifier
z. PNP transistor
aa. .68 microfarad capacitor
bb. .0022 microfarad capacitor
cc. 100 k ohm potentiometer (built into ET-3100)
dd. 1 k ohm potentiometer (built into ET-3100)
ee. Oscilloscope with probes
ff. .001 microfarad ceramic capacitor
gg. .1 microfarad Mylar capacitor

TASK

EC-14 Testing and repairing nonsinusoidal amplifiers

PERFORMANCE OBJECTIVE

Test and repair nonsinusoidal amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wave shaping circuit operation
b. Theory of wave shaper circuits
c. Discrete and IC wave shaper circuits
d. Method of troubleshooting

Provide Demonstration On:

a. How to test the wave shaping circuit
b. Normal malfunctions of wave shaper circuit
c. How to troubleshoot
d. How to repair

Provide Practical Application On:

a. Inspecting and testing good wave shaper circuits
b. Troubleshooting and repairing wave shaper circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Active Filters
b. Heathkit, IC Timers
c. Heathkit, Electronic Circuits
d. Horowitz and Hill, The Art of Electronics

Student Manuals:

Heathkit, Electronic Circuits, Student Workbook

Tools and Equipment:

a. Wave shaper circuits
b. Oscilloscope
c. Voltmeter
d. Schematic manual
e. Manual
f. Screwdrivers, blade, assorted

(Continued on back)

LAB HOURS	8
CLASS HOURS	4

EVALUATION (EC-14)

Given a wave shaping amplifier, schematic and the necessary tools and equipment, the student will perform an operational check on the amplifier and repair any malfunctions. The repaired amplifier must meet the specific standards of operation.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

g. Screwdrivers, Phillips head, assorted
h. Wrenches, adjustable
i. Iron, soldering
j. Solder, resin core
k. Pliers, needle nose
l. Pliers, diagonal
m. Flashlight

TASK

EC-15 Analyzing amplitude modulator (AM) circuits

PERFORMANCE OBJECTIVE

Analyze amplitude modulator (AM) circuits

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Characteristics of AM
   1. The radio wave
   2. Sidebands
   3. Bandwidth
   4. Percent of modulation
b. Production and transmission of AM
c. AM detection and demodulation
   1. AM receivers
   2. The tuned RF receiver
   3. The superheterodyne receiver
   4. Mixers and frequency converters

(Continued on back)

Provide Demonstration On:

Identifying electrical characteristics and operating values of amplitude modulators (AM) and AM detectors

Provide Practical Application On:

a. Drawing a block diagram of a series-modulation system
b. Mixing signals in linear and non-linear devices
c. Analyzing an AM transmitter signal

INSTRUCTIONAL MATERIALS

Textbooks:

Heathkit, Electronic Circuits

Student Manuals:

a. Heathkit, Electronic Circuits, Student Workbook
b. Georgia, Electronics, Phase C

Tools and Equipment:

a. Multimeter with leads
b. Oscilloscope with probe
c. Heathkit Experimenter (ET-3100 or equivalent)
d. Standard AM radio
e. Hook-up wire
f. Two NPN silicon transistors
g. Germanium diode
h. Transformer

(Continued on back)

LAB HOURS 12

CLASS HOURS 8

EVALUATION (EC-15)

a. Given the necessary instructions, supplies and equipment, the student will construct an oscillator that will produce a modulated signal in the AM broadcast bond and an AM detector which can recover intelligence from the RC carrier. Identify and record the electrical characteristics and operating values of the modulator and detector, including the percentage of modulation.

b. Test and review questions can be found in:
   1. Heathkit, Electronic Circuits, Student Workbook.
   2. Georgia, Electronics, Phase C.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   5. The I-F amplifier
   6. Automatic volume control (AVC)
   7. An AM radio schematic

d. Other AM systems
   1. Disadvantages of standard AM
   2. Single sideband
   3. Supressing components
   4. The balanced modulator
   5. AM and SSB variations

INSTRUCTIONAL MATERIALS

Tools and Equipment:

i. 1 Megohm, 1/2-watt resistor
j. 100 k ohm, 1/2-watt resistor
k. 68 k ohm, 1/2-watt resistor
l. 10 k ohm, 1/2-watt resistor
m. 0.1 microfarad capacitor
n. 0.0022 microfarad capacitor
o. 100 pF capacitor
p. 2.7 pF capacitor
q. Alignment tool
r. 1 k ohm potentiometer (built into ET-3100)

TASK

EC-16 Analyzing frequency modulator (FM) circuits

PERFORMANCE OBJECTIVE

Analyze frequency modulator (FM) circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Characteristics of FM
    1. FM wave form
    2. Modulation percentage
    3. Sidebands
b. Modulator systems
    1. Direct FM
    2. Indirect FM
    3. Reactance tube modulator
    4. Serrasiod phase modulator
    5. Deviation ratio
    6. Modulation index
c. The FM transmitter
d. The FM receiver

(Continued on back)

Provide Demonstration On:

Identifying electrical characteristics and operating values of frequency modulators and detectors

Provide Practical Application On:

Constructing and analyzing the operation of FM circuits

INSTRUCTIONAL MATERIALS

Textbooks:

Heathkit, Electronic Circuits

Student Manuals:

a. Heathkit, Electronic Circuits, Student Workbook
b. Georgia, Electronics, Phase C

Tools and Equipment:

a. Oscilloscope
b. Audio generator
c. Multimeter
d. FM radio

LAB HOURS	12
CLASS HOURS	8

EVALUATION (EC-16)

a. Given an FM radio and the necessary supplies and equipment, the student will identify the electrical characteristics and operating values of frequency modulators (FM) and FM detectors. Data must be identified and recorded.

b. Test and review questions can be found in:
   1. Heathkit, Electronics Circuits, Student Workbook.
   2. Georgia, Electronics, Phase C.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

e. FM detectors
   1. Slope detector
   2. Double-tuned detector
   3. Foster-Seeley discriminator
   4. Ratio detector
   5. Gated-beam detector

f. FM stereo
   1. FM stereo reception
   2. Stereophonic multiplexing

g. SCA

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TASK

EC-17 Analyzing the operation of superheterodyne receivers

PERFORMANCE OBJECTIVE

Analyze the operation of superheterodyne receivers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Review tuned RF receiver
b. RF signal generator
c. Circuitry of a superheterodyne receiver
    1. AF amplifiers
    2. Review IF amplifiers
    3. Review RF amplifiers
    4. Review oscillators
    5. Review mixers
    6. Review AVC

Provide Demonstration On:

a. Alignment of an experimental superheterodyne receiver
b. Voltage and current measurements in a transistor superheterodyne receiver

Provide Practical Application On:

Having the student construct a superheterodyne receiver, perform condition test of the receiver and record test data

INSTRUCTIONAL MATERIALS

Textbook:

Georgia, Electronics, Phase C

Tools and Equipment:

a. Communications receiver, Heathkit model SB-310 or equivalent
b. Table model radio receiver, Heathkit model GR-1008 or equivalent
c. Schematics for above
d. Dummy loads for loudspeaker
e. Oscilloscope
f. VTVM
g. Signal generator
h. Superheterodyne receiver kit
i. Screwdrivers, blade, assorted
j. Screwdrivers, Phillips head, assorted
k. Wrenches, adjustable
l. Iron, soldering
m. Solder, resin core
n. Pliers, needle nose
o. Pliers, diagonal
p. Flashlight
q. Alignment tools

LAB HOURS 12
CLASS HOURS 6

EVALUATION (EC-17)

a. Given the necessary instructions, supplies and equipment, the student will construct a superheterodyne receiver, align the receiver, make a signal tracing check and take voltage measurements. The completed radio must meet construction and testing specifications.

b. Test and review questions can be found in Georgia, Electronics, Phase C.

TASK

EC-18 Servicing tape recorders

PERFORMANCE OBJECTIVE

Service tape recorders.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of tape recorders and tape players
b. Principles of operation
c. Basic maintenance and evaluation procedures
d. Tape transport problems
e. Recording problems
f. Reproduction problems
g. Troubleshooting techniques

Provide Demonstrations On:

a. Troubleshooting techniques
b. Use of test equipment

Provide Practical Application On:

a. Routine maintenance procedures
b. Diagnosing and repairing tape recorder problems
c. Analyzing tape recorder electronics

INSTRUCTIONAL MATERIALS

Textbooks:

Middleton, Tape Recorder Servicing Guide

Tools and Equipment:

a. Tape recorders and players
b. Audio VTVM
c. Oscilloscope
d. Screwdriver set
e. Nut driver set
f. Combination wrench set
g. Pliers, tweezers
h. Field-effect multimeter
i. Cleaning solutions, swabs
j. Lubricants and applicators
k. Tape strobe
l. Head demagnetizer
m. Spring torque measurer
n. Magnifying glass
o. Single and double lens loapes

LAB HOURS 12

CLASS HOURS 6

EVALUATION (EC-18)

Given tape recorders with various malfunctions and the tools and equipment listed for this task, the student will correctly diagnose and repair the malfunctions.

TASK

EC-19 Servicing record changers

PERFORMANCE OBJECTIVE

Service record changers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Changer types and principles of operation
b. Basic maintenance and evaluation procedures
c. Change cycle drive problems
d. Trip-mechanism troubles
e. Pickup-arm and assembly
f. Record-dropping-mechanism
g. Set-down indexing problems
h. Cartridge and needle problems
i. Drive and turntable problems
j. Motor problems
k. Troubleshooting techniques

Provide Demonstration On:

a. Types of changers
b. Troubleshooting procedures

Provide Practical Applications On:

a. Routine maintenance procedures
b. Diagnosing and repairing record changer problems

INSTRUCTIONAL MATERIALS

Textbooks:

Middleton, Record Changer Servicing Guide

Tools and Equipment:

a. Record changers
b. VTVM
c. Audio oscillator
d. Screwdrivers, nut drivers
e. Pliers
f. Hex key wrenches
g. Tweezers
h. Lubricants
i. Turntable strobe

LAB HOURS 12
CLASS HOURS 6

EVALUATION (EC-19)

Given turntables with various malfunctions and the tools and equipment listed for this task, the student will correctly identify the cause and repair each malfunction.

222

TASK

EC-20 Inspecting and repairing loudspeakers

PERFORMANCE OBJECTIVE

Inspect and repair loudspeakers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of loudspeakers and methods of mounting
b. Usual faults of loudspeakers
c. Procedures for locating faults
    1. Visual inspection
    2. Ohmmeter checks
d. Decision to repair or replace
e. Procedures for repairing and replacing
f. Condition test to verify equipment conforms to specifications

Provide Demonstration On:

a. Techniques of visual inspection of loudspeakers
b. Techniques for locating defects
c. Procedure for repair or replacement
d. Performing condition tests

Provide Practical Application On:

a. Inspecting and locating defects in loudspeakers
b. Determining if repair or replacement is necessary
c. Procedures for repair or replacement
d. Final inspection for compliance to specifications

INSTRUCTIONAL MATERIALS

Textbooks:

a. Equipment service manuals
b. Parts catalogs

Tools and Equipment:

a. Screwdrivers
b. Wrenches
c. Soldering iron
d. Solder
e. Pliers
f. Flashlight
g. Loudspeaker
h. VOM

LAB HOURS	8
CLASS HOURS	4

EVALUATION (EC-20)

a. Given equipment, tools, supplies, ohmmeter and references, the student will locate defective speakers and repair or replace as necessary. Replacement or repair action must maintain equipment specifications.

b. V'TECS, Radio-Television, Task No. 21.

c. V'TECS, Radio Communications Technician, Task No. 20.

TASK

EC-21 Inspecting and repairing microphones

PERFORMANCE OBJECTIVE

Inspect and repair microphones.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of microphones
b. Usual defects found in microphones
c. Procedures for locating defects
   1. Visual inspection
   2. Instrument checks
d. Decision to repair or replace
e. Procedure for repairing and replacing
f. Condition test to verify equipment conforms to specifications

Provide Demonstration On:

a. Techniques of visual inspection
b. Techniques of fault detection using instruments
c. Procedure for repair or replacement
d. Performing condition test

Provide Practical Application On:

a. Inspecting for and locating defects in microphones

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Equipment service manuals
b. Parts catalogs

Tools and Equipment:

a. Screwdrivers
b. Wrenches
c. Soldering iron
d. Solder
e. Pliers
f. Flashlight
g. Microphones
h. VOM
i. EVM
j. Oscilloscope
k. Speaker repair kit

LAB HOURS	8
CLASS HOURS	4

EVALUATION (EC-21)

a. Given equipment, tools, supplies, test instruments and references, the student will inspect defective microphones, determine the defects and repair or replace as necessary. Replacement or repair action must return unit to original specifications.

b. V'TECS, Electronics Mechanics, Task No. F-22.

c. V'TECS, Radio-Television, Task No. 32.

d. V'TECS, Radio Communications Technician, Task Nos. 15 and 19.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

b. Determining if repair or replacement action is needed
c. Procedure for repair and replacement
d. Final inspection for compliance to specifications

226

TASK

EC-22 Laying out, taping up and drawing basic printed circuit boards

PERFORMANCE OBJECTIVE

Layout, tape up and draw basic printed circuit boards.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Schematic diagrams
b. Printed circuitry processes
c. Materials
d. Specifications
e. Conductor and components
    1. Conductor size
    2. Termination areas
    3. Specialized conductors in termination tapes
    4. Films and grids
    5. Tape application
    6. Tape and termination pad selection
f. Printed board design
g. Printed board layout

(Continued on back)

Provide Demonstration On:

Techniques for laying out, taping up and/or drawing printed circuit boards

Provide Practical Application On:

a. Drawing a PC board diagram
b. Laying out and taping up a PC board

INSTRUCTIONAL MATERIALS

Textbooks:

a. Raskhodoff, Electronic Drafting and Design
b. Lindsey, The Design and Drafting of Printed Circuit Boards

Tools and Equipment:

a. Drafting kit
b. Dry transfer printed circuit boards art work materials
c. Chartpak
d. Printed circuit board template

LAB HOURS	24
CLASS HOURS	6

EVALUATION (EC-22)

a. Given a basic electronic schematic, reference data, printed circuit art work supplies, drafting supplies and the necessary equipment, the student will lay out, tape up and draw the foil and component side art work necessary for fabricating a printed circuit board.

b. V'TECS, Electronics Mechanics, Task No. C-9.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

h. Component mounting
i. Integrated circuit grouping
j. Multi-layer printed circuit boards
k. Assembling drawing and parts layout
l. Designing reference information

TASK

EC-23 Constructing printed circuit (PC) boards

PERFORMANCE OBJECTIVE

Construct printed circuit boards.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of PC board materials
b. Chemicals used in making a PC board
c. Step-by-step procedure to make a PC board

Provide Demonstration On:

a. How to clean and prepare the PC board
b. Photoetching techniques

Provide Practical Application On:

Constructing PC boards from circuit diagrams

INSTRUCTIONAL MATERIALS

Textbooks:

Lindsey, The Design and Drafting of Printed Circuit Boards

A/Vs:

Georgia, Electronics Technology, Phase A, "Printed Circuits," slide/tape 25-B

Student Manuals:

Georgia, Electronics, Phase B, Unit 25-B

Tools and Equipment:

a. PC board kit
b. Circuit to be made on PC board
c. Darkroom if photo kit is used
d. Etchant solution

LAB HOURS	24
CLASS HOURS	6

EVALUATION (EC-23)

a. Given the necessary materials to construct a PC board, the student will lay out a specified circuit pattern and develop the finished PC board product. The student will install the components on the PC board and perform a proof of performance to prove the board will function correctly.

b. V'TECS, Electronics Mechanics, Task No. E-14.

c. Ohio, Communication Electronics, Performance Test Items.

TASK

TV-01 Analyzing the stages of a black and white TV receiver

PERFORMANCE OBJECTIVE

Analyze the stages of a black and white TV receiver.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Characteristics of the eye important to TV systems
- b. Picture transmission
    - 1. Parallel
    - 2. Sequential scanning
    - 3. Scanning lines
- c. Raster formation
    - 1. The vidicon
    - 2. Picture tube
    - 3. Magnetic deflection
    - 4. The sawtooth
- d. Horizontal deflection and interlace scanning
- e. Scanning frequencies
- f. The seven-line raster
- g. The video signal and video frequency range
- h. Picture recomposition
- i. The composite video signal
    - 1. Blanking
    - 2. Horizontal sync and blanking
    - 3. Vertical sync and blanking
    - 4. The hammerhead pattern
    - 5. The vertical interval test signal (VITS)
- j. The modulated video
    - 1. Amplitude modulation
    - 2. Vestigial sideband transmission
    - 3. Frequency modulation
    - 4. TV station frequency allocations

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Liff, Color and Black and White Television, Theory and Servicing
- b. Tinnell, Television Symptom Diagnosis

Student Manuals:

- a. Georgia, Electronics, Phase C
- b. Tinnell, Television Symptom Diagnosis

LAB HOURS	12
CLASS HOURS	6

EVALUATION (TV-01)

a. The student will sketch a basic block diagram of the necessary elements in the TV transmitter and TV receiver for picture transmission and reception. The student will describe the basic concepts of a television system on a written test.

b. Review and test questions can be found in:
   1. Liff, Color and Black and White Television, Theory and Servicing, Chapter 2.
   2. Georgia, Electronics, Phase C.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

k. The black and white television receiver
   1. The stages of the receiver
   2. The functions of each stage

TASK

TV-02 Analyzing low voltage power supplies

PERFORMANCE OBJECTIVE

Analyze low voltage power supplies.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Voltage regulation in the power supply
b. Stages of the primary power supply
    1. The primary circuit
    2. The secondary circuit and ferroresonant
    3. The rectifier stage
    4. The filter section
    5. The distribution system
c. Making a leakage current check
d. Troubleshooting power supplies

Provide Demonstration On:

a. The primary circuit
b. The secondary circuit
c. Testing rectifiers
d. The filter section
e. The distribution system
f. Making a leakage current check
g. Regulation, secondary AC voltage
h. Regulation, B+ with load
i. Filtering, ripple measurement

Provide Practical Application On:

Having the learner perform procedures to isolate problems in a low voltage power supply

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, Motorola Quasar Projects
b. Liff, Color and Black and White Television, Theory and Servicing
c. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. VOM, VTVM or digital multimeter
b. 2 jumper leads
c. 1500 ohm, 1-watt resistor
d. 3 inch insulated sleeving
e. Oscilloscope with vertical calibration
f. 3 1200 ohm, 10 watt resistors
g. Soldering iron

(Continued on back)

LAB HOURS 2

CLASS HOURS 2

EVALUATION (TV-02)

a. Given a low voltage power supply and the necessary tools and equipment, the student will carry out proper procedures (ie., measure voltages and resistances, locate shorts and opens, etc.) for isolating problems in the simple parallel and series circuits of the primary power supply. Any malfunctions must be identified.

b. Test and review questions can be found in Quasar, Motorola Quasar Projects.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. Variac
i. Primary power supply circuit or a television

TASK

TV-03 Troubleshooting switch-mode secondary voltage supplies

PERFORMANCE OBJECTIVE

Troubleshoot switch-mode secondary voltage supplies.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The horizontal panel
    1. The 200-volt supply
    2. The 20-volt supply
    3. Electronic regulation of voltage
b. Transistor operation
c. Troubleshooting techniques
    1. The 200-volt supply
    2. The 20-volt supply
    3. Transistor components
    4. Modular circuits
d. Effect of driver stage output on oscillator frequency

Provide Demonstration On:

a. Adjusting regulated supplies
b. Troubleshooting modular circuits
c. Checking transistors "out-of-circuit"
d. Testing transistors "in circuit"
e. Electronic regulation with load variations
f. Driver wave form regulator adjustment
g. Output voltages versus oscillator frequency changes
h. Troubleshooting: 20-volt supply 0V, 200-volt supply 105V

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, Motorola Quasar Projects
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. VOM, VTVM or digital multimeter
b. Hex alignment tool
c. Independent power supply
d. "FC" panel
e. Soldering iron (40-watt or smaller and solder)
f. 2 200 ohm, 5-watt resistors
g. 2 10K ohm, 7-watt resistors

(Continued on back)

LAB HOURS 12

CLASS HOURS 4

EVALUATION (TV-03)

a. Given a defective switch-mode secondary voltage supply and the necessary tools and equipment, the student will isolate and correct defective modular circuits and adjust the circuitry to specifications.

b. Test and review questions are available in Quasar, Motorola Quasar Projects.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Troubleshooting switch-mode secondary voltage supplies

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. 4 male power plug pins
i. Oscilloscope and probe
j. One-inch length of wire

TASK

TV-04 Troubleshooting synchronizing and deflection circuits

PERFORMANCE OBJECTIVE

Troubleshoot synchronizing and deflection circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Synchronizing and deflection circuits
    1. Function position
    2. Separation in receiver
b. Amplitude separation
c. Wave form separation
    1. The differentiator
    2. The integrator
d. Types of sync separator circuits
    1. Vacuum tube sync separators
    2. Transistor sync separators
    3. Gated tube sync separators
e. Noise setup

(Continued on back)

Provide Demonstration On:

Troubleshooting
a. Common sync stages
b. AFC circuits
c. Horizontal oscillator
d. Vertical oscillator

Provide Practical Application On:

a. Introducing a problem into a television sync circuit
b. Having learner troubleshoot the circuit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Oscilloscope
b. VTVM
c. Television receiver
d. Screwdrivers, blade, assorted
e. Screwdrivers, Phillips head, assorted
f. Wrenches, adjustable
g. Iron, soldering
h. Solder, resin core
i. Pliers, needle nose
j. Pliers, diagonal
k. Flashlight

LAB HOURS	12
CLASS HOURS	6

EVALUATION (TV-04)

Given a television receiver with a defective sync circuit and the necessary tools and equipment, the student will troubleshoot the sync circuits. Defect(s) must be identified and corrected so that the receiver meets manufacturer's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

f. Sync separator troubleshooting
g. The deflection oscillator and the sawtooth wave form
h. The discharge transistor
i. The trapezoid wave form and generator
j. The sawtooth oscillator
k. The blocking oscillator
l. The ringing coil
m. Multivibrators
n. Synchronization of deflection oscillators
o. Sine wave horizontal deflection oscillators
p. Troubleshooting deflection oscillators
q. Automatic frequency control (AFC)
    1. Phase detector AFC
    2. Troubleshooting AFC units
r. The given AFC detector
s. Anti-hunt circuits

TASK

TV-05 Troubleshooting horizontal output circuits

PERFORMANCE OBJECTIVE

Troubleshoot horizontal output circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Horizontal output amplifier systems
   1. Stages of the system
   2. Comparison of horizontal output stage in color and black and white
b. The vacuum tube horizontal output amplifier
c. B+ boost troubleshooting
d. Flyback transformer and yoke
e. Horizontal output amplifier controls
f. High-voltage focus supplies and focus circuit troubleshooting

(Continued on back)

Provide Demonstration On:

Troubleshooting horizontal output circuits

Provide Practical Application On:

a. Introducing a problem into a horizontal output circuit
b. Having the learner troubleshoot the circuit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Jumpers
b. VTVM
c. Oscilloscope
d. Power supply
e. Screwdrivers, blade, assorted
f. Screwdrivers, Phillips head, assorted
g. Wrenches, adjustable
h. Iron, soldering

(Continued on back)

LAB HOURS	12
CLASS HOURS	6

EVALUATION (TV-05)

Given a television receiver and the necessary tools and equipment, the student will perform an operational check on the horizontal output circuit. All malfunctions must be identified and corrected to operational specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. High-voltage rectifiers and troubleshooting HV circuits
h. High-voltage generation and regulation
    1. In solid state receivers
    2. Hold-down circuits
i. The transistor horizontal output amplifier
j. The horizontal driver stage
k. The horizontal output stage
l. The NPN transistor horizontal output stage
m. The SCR horizontal deflection circuit and SCR troubleshooting

INSTRUCTIONAL MATERIALS

Tools and Equipment:

i. Solder, resin core
j. Pliers, needle nose
k. Pliers, diagonal
l. Flashlight
m. TV receiver

TASK

TV-06 Troubleshooting sweep-generator circuits

PERFORMANCE OBJECTIVE

Troubleshoot sweep-generator circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sweep-generator theory and operation
b. Troubleshooting with test equipment
c. Basic repair techniques

Provide Demonstration On:

a. Testing the sweep-generator circuits
b. Abnormal operating conditions of the generator
c. Troubleshooting and repairing the generator

Provide Practical Application On:

a. Testing sweep-generator circuits and identifying the defective circuits
b. Repairing any defects and retesting the generator circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. McGraw-Hill, A Programmed Course in Basic Pulse Circuits
b. Heathkit, Electronic Circuits
c. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Sweep-generator
b. Oscilloscope
c. Schematic and manual
d. Hand tools
e. Voltmeter
f. Screwdrivers, blade, assorted
g. Screwdrivers, Phillips head, assorted
h. Wrenches, adjustable

(Continued on back)

LAB HOURS	12
CLASS HOURS	6

EVALUATION (TV-06)

Given a sweep-generator, manual, schematic and the necessary tools and equipment, the student will perform an operational check on the circuits. Any malfunctions must be identified and corrected to operational specifications.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

i. Iron, soldering
j. Solder, resin core
k. Pliers, needle nose
l. Pliers, diagnoal
m. Flashlight

TASK

TV-07 Troubleshooting high voltage supplies

PERFORMANCE OBJECTIVE

Troubleshoot high voltage supplies.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The need for high voltage
b. Components of the horizontal output stage
    1. Horizontal output transistor
    2. Horizontal output (flyback) transformer
    3. High voltage rectifier
    4. Deflection yoke
c. Focus voltage
d. Screen (G2) voltage and troubleshooting
e. Effect of change in horizontal frequency on high voltage

(Continued on back)

Provide Demonstration On:

a. Measuring high voltage
b. Horizontal frequency
c. Estimating high voltage without a probe
d. Checking for high voltage AC
e. Testing solid state high voltage rectifiers
f. Focus voltage
g. Troubleshooting the G2 supply
h. The horizontal output pulse
i. Additional high voltage transformer pulses

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, *Motorola Quasar Projects*
b. Heathkit, *Electronic Circuits*
c. Tinnell, *Television Symptom Diagnosis*

Student Manuals:

Tinnell, *Television Symptom Diagnosis*

Tools and Equipment:

a. Complete power supply and yoke
b. High voltage probe or meter
c. VOM, VTVM or digital multimeter
d. Neon tester
e. Insulated screwdriver (not wood handle)

(Continued on back)

LAB HOURS 12

CLASS HOURS 6

EVALUATION (TV-07)

Given a color television receiver with a defective high voltage supply, manual, schematic and the necessary tools and equipment, the student will perform an operational check on the high voltage supply. All malfunctions must be identified and corrected to operational specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

f. The neon bulb test
g. PRV (peak-reverse-voltage) ratings
h. The horizontal output pulse
i. Safety practices and procedures
j. Spark gap protection devices

Provide Demonstration On:

j. Horizontal size coil versus horizontal deflection
k. The "stacked" G2 supply

Provide Practical Application On:

Having the learner practice performing operational checks on a high voltage supply, identifying malfunctions and indicating procedure for corrections

INSTRUCTIONAL MATERIALS

Tools and Equipment:

f. Soldering iron
g. Oscilloscope and probe (low capacitance)
h. Hex adjusting tool
i. Schematic and manual

TASK

TV-08 Aligning the CRT and associated circuits

PERFORMANCE OBJECTIVE

Align the CRT and associated circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Components of CRT and their functions
b. The horizontal sweep system
c. Degaussing
d. Elementary CRT adjustments
e. CRT voltages
f. Filament voltage
g. Safety

Provide Demonstration On:

a. High voltage-with and without the CRT
b. CRT socket supply voltages
c. Adjusting the G2 screen controls
d. Horizontal sweep
e. Purity rough-in
f. Checking the degaussing circuit

Provide Practical Application On:

Having the learner practice aligning CRTs and associated circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, Motorola Quasar Projects
b. Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. High voltage probe 930 KV or higher
b. VOM, VTVM or digital multimeter
c. CRT
d. Schematic and manual
e. Alignment tools

LAB HOURS 10

CLASS HOURS 2

EVALUATION (TV-08)

a. Given a black-and-white or color television receiver, schematics, manual and the necessary tools and equipment, the student will adjust the CRT and associated circuits to operational specifications.

b. Test and review questions can be found in:
   1. Quasar, Motorola Quasar Projects.
   2. Tinnell, Television Symptom Diagnosis.

TASK

TV-09 Troubleshooting vertical deflection circuits

PERFORMANCE OBJECTIVE

Troubleshoot vertical deflection circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Deflection circuit function and arrangement
b. The vertical output amplifier
c. Transistor power amplifiers
d. Vertical linearity
e. Commonly used vertical deflection circuits
f. The vertical deflection multivibrator
g. The three-stage transistor multivibrator
h. The Miller rundown vertical deflection circuit

(Continued on back)

Provide Demonstration On:

Troubleshooting a vertical deflection circuit

Provide Practical Application On:

Having the learner practice troubleshooting various malfunctions in a vertical deflection circuit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptoms Diagnosis

Tools and Equipment:

a. Television receiver
b. Oscilloscope
c. VTVM
d. Schematic and manual
e. Screwdrivers, blade, assorted
f. Screwdrivers, Phillips head, assorted
g. Wrenches, adjustable
h. Iron, soldering
i. Solder, resin core

(Continued on back)

LAB HOURS	16
CLASS HOURS	

EVALUATION (TV-09)

a. Given a black-and-white or color television receiver, schematics, manual and the necessary tools and equipment, the student will troubleshoot the vertical defelction circuit. All malfunctions must be identified.

b. Review and test questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Vertical deflection circuit

INSTRUCTIONAL MATERIALS

Tools and Equipment:

j. Pliers, needle nose
k. Pliers, diagonal
l. Flashlight

TASK

TV-10 Adjusting the purity, focus and gray scale to produce a normal raster

PERFORMANCE OBJECTIVE

Adjust the purity, focus and gray scale to produce a normal raster.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Producing full raster
b. Wave forms from the vertical sweep section

Provide Demonstration On:

a. Modular circuit voltage measurements
b. Load versus supply voltages
c. Raster adjustments
d. Wave forms of DC supply line
e. Vertical oscillator wave form
f. Vertical deflection wave form
g. Additional outputs from the "VA" panel

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, Motorola Quasar Projects
b. Tinnell, Television Symptom Diagnosis

Student Manual:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. VOM, VTVM or digital multimeters
b. Hex alignment tool
c. Oscilloscope and probe
d. Soldering iron
e. Jumper cable
f. Screwdrivers, blade, assorted
g. Screwdrivers, Phillips head, assorted
h. Wrenches, adjustable

(Continued on back)

LAB HOURS	8
CLASS HOURS	

EVALUATION (TV-10)

a. Given a television receiver, schematics, manual and the necessary tools and equipment, the student will adjust the purity, focus and gray scale to produce a normal raster.

b. Test and review questions can be found in Quasar, Motorola Quasar Projects.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

i. Solder, resin core
j. Pliers, needle nose
k. Pliers, diagonal
l. Flashlight

TASK

TV-11 Analyzing the operation of video amplifiers

PERFORMANCE OBJECTIVE

Analyze the operation of video amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of video amplifiers
b. Picture tube light output characteristics
c. Amplifier distortion
d. Types of amplifier distortion
e. Video frequency and picture content
f. Methods of frequency compensation
g. High-frequency compensation
h. Low-frequency distortion
i. DC restorers and methods of restoration
j. Video amplifier controls and typical circuits
k. Brightness limiters
l. Peaking controls
m. Automatic brightness control
n. Spot killer circuits
o. The delay line
p. Retrace blanking circuits
q. Video amplifier troubleshooting

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

LAB HOURS	
CLASS HOURS	14

EVALUATION (TV-11)

a. Given a television receiver or schematic of a video amplifier, the student will describe the components and operational characteristics of the amplifier. Evaluation will be based on specifications established by the instructor.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

TASK

TV-12 Troubleshooting defective video amplifiers

PERFORMANCE OBJECTIVE

Troubleshoot video amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Brightness and bias voltage
b. Controls
    1. Peaking-intensity-hue
    2. Picture control
    3. Super insta-matic
    4. Energy saver switch
c. Operation of the video panel
d. The gray scale
e. Blanking circuitry
f. Troubleshooting techniques
    1. Noise injection
    2. 60 Hz signal injection
    3. Generator injection

Provide Demonstration On:

a. Video panel supply voltages
b. Picture control voltages
c. Preliminary set up adjustments ("CC" panel only)
d. Video signal injection
e. 60 Hz signal injection
f. Generator injection
g. Blanking signals
h. The energy saver switch

Provide Practical Application On:

Having the student troubleshoot a variety of video amplifiers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, Motorola Quasar Projects
b. Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Video amplifier
b. VOM, VTVM or digital multimeter
c. Jumper lead
d. Oscilloscope
e. .1 microfarad, 400 V capacitor
f. 33 K ohm, 1/2-watt resistor
g. 680 ohm, 1/2-watt resistor
h. 3 alligator clips
i. Wire, 24 inch length

(Continued on back)

LAB HOURS 12

CLASS HOURS

EVALUATION (TV-12)

a. Given the necessary materials and equipment, the student will adjust the gray scale, use an audio oscillator to produce a video pattern, determine the existence of video amplification by voltage measurements and use noise injection and low frequency line voltage troubleshooting techniques. Malfunctions must be identified.

b. Test and review questions can be found in Quasar, Motorola Quasar Projects.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

j. Insulated sleeving, 3 inches long
k. Variable frequency audio oscillator

TASK

TV-13 Analyzing video IF amplifiers

PERFORMANCE OBJECTIVE

Analyze video IF amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. IF stages
b. The video IF strip
c. Intercarrier sound
d. IF response
e. Color receiver IF response
f. Coupling methods
g. The integrated circuit video IF amplifier
h. The video detector
i. Troubleshooting the video IF amplifier and detector

Provide Demonstration On:

a. Schematics of the IF stages
b. Troubleshooting techniques

Provide Practical Application On:

Analyzing video IF amplifier circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

Video IF amplifiers or schematics

LAB HOURS	6
CLASS HOURS	6

EVALUATION (TV-13)

a. Given a television receiver or schematic of a video IF amplifier, the student will describe the components and operational characteristics of the amplifier. Evaluation will be based on specifications established by the instructor.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

TASK

TV-14 Aligning RF and IF amplifiers

PERFORMANCE OBJECTIVE

Align RF and IF amplifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Signal generators
    1. The marker generator
    2. The sweep generator
b. Marker systems
    1. The marker generator
    2. The absorption marker
    3. The intensity marker
c. VHF tuner alignment
d. Video IF sweep alignment
e. The alignment process
    1. Alignment equipment
    2. Alignment hook-up
    3. Alignment procedures and precautions

Provide Demonstration On:

Procedures for performing condition testing and aligning RF and IF amplifiers

Provide Practical Application On:

Having the student practice performing condition testing and aligning RF and IF amplifiers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, *Color and Black and White Television, Theory and Servicing*
b. Tinnell, *Television Symptom Diagnosis*

Student Manuals:

Tinnell, *Television Symptom Diagnosis*

Tools and Equipment:

a. VTVM
b. Oscilloscope
c. IF amplifier
d. RF amplifier
e. Schematics
f. Screwdrivers, blade, assorted
g. Screwdrivers, Phillips head, assorted
h. Wrenches, adjustable

(Continued)

LAB HOURS	8
CLASS HOURS	4

EVALUATION (TV-14)

a. Given an RF and an IF amplifier, schematics, manuals and the necessary tools and equipment, the student will align the amplifiers. The correct procedures must be used and the amplifiers must be aligned to specifications.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

i. Iron, soldering
j. Solder, resin core
k. Pliers, needle nose
l. Pliers, diagonal
m. Flashlight

TASK

TV-15 Analyzing the operation of sound IF and AM circuits

PERFORMANCE OBJECTIVE

Analyze the operation of sound IF and AM circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Comparison of TV sound system with commercial FM receivers
b. Sound IF amplifiers
c. Sound IF amplifier circuits
d. Solid state IF amplifiers
e. An IC sound IF amplifier
f. Sound detectors
    1. The gated beam detector
    2. The quadrature grid locked-in oscillator detector
    3. The ratio detector and troubleshooting the ratio detector
    4. Integrated circuit detectors
g. Audio amplifiers
h. Transistor audio power amplifiers
i. Heat sinks
j. Troubleshooting the sound strip

Provide Practical Application On:

Troubleshooting techniques

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. TV
b. FM receiver
c. VTVM
d. Oscilloscope

LAB HOURS	8
CLASS HOURS	4

EVALUATION (TV-15)

a. Given sound IF and AM circuits schematics and test instruments, the student will analyze the operation of the circuits. Evaluation will be based on specifications established by the instructor.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

TASK

TV-16 Aligning sound IF and AM circuits

PERFORMANCE OBJECTIVE

Align sound IF and AM circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Circuits of the sound section
b. Troubleshooting techniques
    1. The RF generator
    2. The audio oscillator
    3. Noise
    4. The mid-point troubleshooting technique

Provide Demonstration On:

a. Supply voltages at the IF panel
b. Isolating audio problems with a signal generator
c. Using noise to test the sound section
d. Troubleshooting audio problems
e. Troubleshooting video IF problems

Provide Practical Application On:

Having learner condition test and align several sound IF and AM circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, Motorola Quasar Projects
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. VOM, VTVM or digital multimeter
b. Audio oscillator
c. RF signal generator, modulated
d. .01 microfarad, 600V capacitor
e. Television receiver
f. Alignment tools
g. Schematic

LAB HOURS	9
CLASS HOURS	3

EVALUATION (TV-16)

a. Given a television receiver, schematic and the necessary tools and equipment, the student will condition test and align the sound IF and AM circuits. The circuits must perform to specifications.

b. Review questions can be found in Quasar, Motorola Quasar Projects.

TASK

TV-17 Analyzing VHF and UHF tuner circuits

PERFORMANCE OBJECTIVE

Analyze VHF and UHF tuner circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Television VHF and UHF frequency allocations
b. The VHF tuner
c. Types of VHF tuners
    1. Drum type
    2. Switch type
    3. Electronic tuners
    4. Typical VHF tuners
d. The RF amplifier
    1. Functions of RF amplifier
    2. Types of RF amplifiers
e. The mixer
f. The oscillator

(Continued on back)

Provide Demonstration On:

a. Types of VHF and UHF tuners
b. Troubleshooting techniques

Provide Practical Application On:

Troubleshooting VHF and UHF tuner circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, *Color and Black and White Television, Theory and Servicing*
b. Tinnell, *Television Symptom Diagnosis*

Student Manuals:

Tinnell, *Television Symptom Diagnosis*

Tools and Equipment:

a. VHF tuners
b. UHF tuners
c. Schematics
d. VTVM
e. Oscilloscope

LAB HOURS 12
CLASS HOURS 4

EVALUATION (TV-17)

a. Given VHF tuners, UHF tuners, schematics and test equipment, the student will troubleshoot the tuner circuits and identify all malfunctions.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. The UHF tuners
    1. Typical UHF tuners
    2. Fully transistorized UHF tuner
h. Tuner troubleshooting
i. Cable television
    1. The MATV system
    2. The CATV system

TASK

TV-18 Analyzing automatic fine tuning (AFT) and remote control circuits

PERFORMANCE OBJECTIVE

Analyze AFT and remote control circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Color receiver fine tuning
b. AFT circuits
c. AFT alignment
d. Troubleshooting AFT circuits
e. The remote control system
  1. The remote control transmitter and transmitter circuit
  2. The remote control receiver
  3. On all-electronic remote control system

Provide Demonstration On:

a. Examples of AFT and remote control circuits
b. Troubleshooting techniques

Provide Practical Application On:

Troubleshooting AFT and remote control circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, *Color and Black and White Television, Theory and Servicing*
b. Tinnell, *Television Symptom Diagnosis*

Student Manuals:

Tinnell, *Television Symptom Diagnosis*

Tools and Equipment:

a. AFT circuits
b. Remote control circuits
c. Schematics
d. VTVM
e. Oscilloscope

LAB HOURS 12
CLASS HOURS 4

EVALUATION (TV-18)

a. Given AFT and remote control circuits, schematics and the necessary tools and equipment, the student will troubleshoot the circuits and identify all malfunctions.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

TASK

TV-19 Analyzing automatic gain control (AGC) and noise cancelling circuits

PERFORMANCE OBJECTIVE

Analyze AGC and noise cancelling circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of AGC circuits
b. The ideal AGC system
c. Gain control methods
d. Types of AGC systems
  1. Simple AGC
  2. Keyed AGC
  3. Noise canceling keyed AGC systems
  4. Transistor keyed AGC
e. AGC level controls
f. The complete video IF strip integrated circuit
g. Troubleshooting AGC systems

Provide Demonstration On:

a. AGC trouble symptoms
b. AGC troubleshooting techniques

Provide Practical Application On:

Troubleshooting AGC malfunctions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

a. Zbar, Basic Television: Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. AGC circuits
b. Schematics
c. VTVM

LAB HOURS	12
CLASS HOURS	4

EVALUATION (TV-19)

a. Given faulty AGC and noise canceling circuits, schematics and the necessary tools and equipment, the student will troubleshoot the circuits and correctly identify all malfunctions.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

TASK

TV-20 Analyzing color television signal reception and decoding

PERFORMANCE OBJECTIVE

Analyze color television signal reception and decoding.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Principles of color viewing
   1. Color characteristics
   2. Color mixing
   3. Luminance level
b. The color television transmitter
c. Phase relationships
d. Formation of the chrominance signal
e. I and Q signals
f. Frequency interlocking
g. Composite chrominance signal
h. The color receiver
   1. Circuitry
   2. Stages and controls
   3. Symptoms of defects in each stage

Provide Demonstration On:

The functions of the stages of color receivers

Provide Practical Application On:

Diagnosing symptoms of malfunctions in each stage of color reception and decoding

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Color television receivers
b. Service manuals

LAB HOURS 6

CLASS HOURS 6

EVALUATION (TV-20)

a. Given a block diagram of a color transmitter and a color receiver, the student will identify and describe the functions, stages and principles of operation of color television transmitters and receivers. Evaluation will be based on specifications established by the instructor.

b. Given a set of symptoms associated with color receiver malfunctions, the student will correctly identify the type of malfunction each symptom represents.

c. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

TASK

TV-21 Testing picture tubes and associated circuits

PERFORMANCE OBJECTIVE

Test picture tubes and their associated circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Basic structure of picture tubes
    1. Black and white
    2. Color
b. The electron gun
c. Ion burns
d. The phosphor screen
e. The shadow mask
f. Purity and purity adjustments
g. Automatic degaussing (ADG) circuits
h. Convergence
    1. Static convergence
    2. Dynamic convergence
    3. Convergence circuits
    4. Convergence adjustments

(Continued on back)

Provide Demonstration On:

a. Picture tube testing and troubleshooting
b. Color television receiver controls and adjustments
c. Color receiver set up procedure

Provide Practical Application On:

Picture tube testing and troubleshooting

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

a. Zbar, Basic Television: Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Operating color TV receiver and service manual
b. Adjustment tools
c. Mirror
d. Isolation transformer (if receiver is not line-isolated)
e. Dot-cross-hatch generator

(Continued on back)

LAB HOURS	9
CLASS HOURS	3

EVALUATION (TV-21)

a. Given the necessary tools and equipment, the student will troubleshoot and isolate defective picture tubes and picture tube circuit components. Malfunctions must be identified.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Pincushion cause and correction
j. The gray scale
k. Test jigs
l. The color/bar generator
m. Testing, troubleshooting and adjustment procedures
    1. Picture tubes
    2. Color television receiver controls and adjustments
    3. Color receiver set up procedure

INSTRUCTIONAL MATERIALS

Tools and Equipment:

f. High voltage probe
g. VTVM
h. Degaussing coil
i. One or more picture tubes
j. Picture tube checker and operating instructions

TASK

TV-22 Analyzing band-pass amplifiers, color killer circuits and automatic color control circuits

PERFORMANCE OBJECTIVE

Analyze band-pass amplifiers, color killer circuits and automatic color control circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function and types of color bar generators
b. The color bar pattern
c. Function and types of band-pass amplifiers
  1. The vacuum tube type
  2. The transistor band-pass amplifier
  3. The IC band-pass amplifier
d. Band-pass amplifier alignment
e. Video sweep modulation (VSM)

(Continued on back)

Provide Demonstration On:

a. Troubleshooting techniques
b. Recognizing the symptoms of malfunctions in the band-pass amplifier, color killer circuits and color control circuits

Provide Practical Application On:

Troubleshooting malfunctions in band-pass amplifiers, color killer circuits and color control circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Color TV receivers
b. Service manuals

LAB HOURS 9

CLASS HOURS 3

EVALUATION (TV-22)

a. Given a list of trouble symptoms in band-pass amplifiers, color killer circuits and automatic color control circuits, the student will correctly identify the possible causes of the symptoms.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

f. Troubleshooting the band-pass amplifier
g. Function and types of color killer circuits
h. Troubleshooting the color killer
i. The automatic color control circuit (ACC)
j. Troubleshooting the ACC

TASK

TV-23 Analyzing color sync circuits

PERFORMANCE OBJECTIVE

Analyze color sync circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The burst gate
b. Troubleshooting the burst gate
c. Automatic frequency phase control (AFPC)
d. The phase detector
e. The oscillator control circuit
f. The color oscillator
g. Alignment of the phase detector
h. Troubleshooting the phase detector AFPC
i. Injection locked oscillator AFPC
j. Crystal ringing AFPC
k. The integrated circuit subcarrier processor

Provide Demonstration On:

a. Symptoms of color sync circuit malfunctions
b. Troubleshooting techniques

Provide Practical Application On:

Recognizing symptoms of color sync circuit malfunctions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Color TV receivers
b. Service manuals

LAB HOURS 9

CLASS HOURS 3

EVALUATION (TV-23)

a. Given a list of trouble symptoms in color sync circuits, the student will correctly identify the possible causes of the symptoms.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing, Chapter 17.

TASK

TV-24 Analyzing color demodulator and output amplifier circuits

PERFORMANCE OBJECTIVE

Analyze color demodulator and output amplifier circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of color demodulators
b. Demodulator circuits
c. Low-level demodulators
    1. Transistor demodulators
    2. Pentode demodulators
    3. X and Z demodulators
    4. RGB integrated circuit demodulators
d. High-level demodulators
    1. Characteristics
    2. Twin-pentode demodulator
e. Troubleshooting demodulators
    1. DC coupled demodulators
    2. AC coupled demodulators
    3. RGB integrated circuit demodulators

(Continued on back)

Provide Demonstration On:

a. Types of demodulators
b. Symptoms of demodulator malfunction
c. Troubleshooting techniques

Provide Practical Application On:

Recognizing symptoms of malfunction in demodulators and output amplifier circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Liff, Color and Black and White Television, Theory and Servicing
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Color TV receivers
b. Service manuals

LAB HOURS	9
CLASS HOURS	3

EVALUATION (TV-24)

a. Given a list of trouble symptoms in color demodulators and output amplifier circuits, the student will correctly identify the possible causes of the symptoms.

b. Review questions can be found in Liff, Color and Black and White Television, Theory and Servicing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

f. The vectorscope
g. Automatic tint control circuits (ATC circuits)
h. Other color television systems
    1. PAL
    2. SECAM

TASK

TV-25 Troubleshooting defective color tuning circuits

PERFORMANCE OBJECTIVE

Troubleshoot defective color tuning circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The channel signal and its processing
    1. Synchronizing the picture
    2. Sound IF and audio
    3. AGC and AGC adjustments (review task)
b. Tuners
    1. AFT
    2. UHF and VHF
c. The video-color panel and procession

(Continued on back)

Provide Demonstration On:

a. Tuner adjustments
b. Adjusting the AGC
c. RF-AGC delay adjustment
d. AFT adjustments
e. Sound alignment-the quad coil
f. Color killer adjustment
g. Adjusting hue range
h. Super insta-matic setup
i. Touch-up adjustments
j. Troubleshooting by symptoms
k. Using a scope to set the AGC
l. Tracing the video signal
m. The color signal

Provide Practical Application On:

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, Motorola Quasar Projects
b. Tinnell, Television Symptom Diagnosis

Student Manuals:

Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. TV receiver with antenna system
b. Screwdriver
c. VOM, VTVM or digital multi-meter
d. Hex alignment tool
e. Super insta-matic setup tool
f. Jumper lead
g. High voltage meter, 30KV
h. Oscilloscope
i. RF type cross-hatch generator (optional)
j. Color bar generator

LAB HOURS 12

CLASS HOURS 6

EVALUATION (TV-25)

a. Given the necessary tools and equipment, the student will adjust the following controls for optimum television performance.
   1. UHF and VHF tuners
   2. AGC controls
   3. RF and AGC delay control
   4. AFT
   5. Audio detector (quad coil)
   6. Color killer control
   7. Hue range
   8. Super insta-matic feature

   Each adjustment must meet specifications established by the instructor.

b. Given the necessary equipment, the student will trace the video signal path and the color signal path. The student must be able to trace the paths accurately.

c. Given trouble symptoms, the student will isolate problems to a specific section of a receiver. The specific section must be identified.

d. Review questions can be found in Quasar, Motorola Quasar Projects.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   1. Color sync and oscillators
   2. Hue control
   3. Demodulation

d. Color signal controls
   1. Color killer
   2. Automatic color control

e. Color intensity control
   1. Auto intensity
   2. Super insta-matic

Provide Practical Application On:

Having the learner adjust television receivers, trace signal paths and isolate problems to specific sections

TASK

TV-26 Analyzing and adjusting color convergence circuits

PERFORMANCE OBJECTIVE

Analyze and adjust color convergence circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Convergence
   1. Dynamic
   2. Static
b. Pincushion distortion

Provide Demonstration On:

a. Producing linear raster and pincushion connection
b. Adjusting static and dynamic convergence
c. Troubleshooting sync circuits
d. Adjusting hold controls

Provide Practical Application On:

a. Dot-cross-hatch generator patterns
b. Pre-convergence raster adjustments
c. Static convergence
d. Dynamic convergence
e. Loss of dynamic convergence

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Quasar, Motorola Quasar Projects
b. Tinnell, Television Symptom Diagnosis

Tools and Equipment:

a. Jumper lead
b. Hex-head alignment tool
c. 1/4 inch nut driver
d. Jumper cable
e. 1/4 inch spintite
f. Diagonal cutters
g. Soldering iron or gun
h. Oscilloscope
i. VTVM

LAB HOURS	9
CLASS HOURS	3

EVALUATION (TV-26)

a. Given the necessary materials and equipment, the student will
   1. Adjust vertical size and linearity controls to obtain linear raster
   2. Adjust pincushion coil for proper pincushion correction.
   3. Adjust purity and gray scale
   4. Adjust dynamic and static convergence controls
   5. Use an oscilloscope for troubleshooting sync circuits
   6. Use dot-cross-hatch generator patterns to adjust horizontal and vertical hold controls

   The adjustments must meet specifications established by the instructor.

b. Review questions can be found in Quasar, Motorola Quasar Projects.

SECTION IV

CURRICULUM STRUCTURE, EXIT POINTS & COURSE OUTLINE

SECTION IV

Section IV Content List

Introduction to the Curriculum Structure
Curriculum Structure
  Group
  Individualized
Introduction to Electronics Cluster Exit Points
Introduction to the Course Outline
Course Outline

Section III presented a sample organizational model for sequencing the instruction of program tasks. Based on that model, Section IV provides suggested methods of structuring the entire Electronics Cluster curriculum.

INTRODUCTION TO THE CURRICULUM STRUCTURE

A curriculum structure is developed by sequencing duties into a logical teaching plan. Two curriculum structures are presented in this section - group and individualized.

The individualized structure also lists the duty areas, but does not include hours or quarters. Using the individualized approach, the student proceeds at his or her pace until each task is mastered.

In either type of structure, the duty areas can be rearranged to meet local needs.

ELECTRONICS CLUSTER SUGGESTED CURRICULUM STRUCTURE*

Course	Class Hours	Lab Hours	Total Hours
Quarter I			
Basic Skills	14	118	132
	14	118	132
Quarter II			
Electronic Parts	6	24	30
DC Electronics I	43	47	90
	49	71	120
Quarter III			
DC Electronics II	21	25	46
AC Electronics I	32	46	78
	53	71	124
Quarter IV			
AC Electronics II	30	13	43
Semiconductors	39	45	84
	69	58	127
Quarter V			
Vacuum Tubes	8	18	26
Electronic Circuits I	26	64	90
	34	82	116
Quarter VI			
Electronic Circuits II	42	74	116
	42	74	116
Quarter VII			
Servicing Components	32	88	120
	32	88	120
Quarter VIII			
Television I	40	84	124
	40	84	124
Quarter IX			
Television II	33	77	110
	33	77	110

Course	Class Hours	Lab Hours	Total Hours
Quarter X			
Television III	12	36	48
TV Color Section	27	63	90
	39	99	138
Total Program Hours	405	822	1227

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*This curriculum structure is designed to be used for group instruction.

ELECTRONICS CLUSTER CURRICULUM STRUCTURE*

Course	Class Hours	Lab Hours	Total Hours
Semester I			
Basic Skills	20	142	162
Introduction to DC Electronics	8	10	18
	28	152	180
Semester II			
DC Electronics	56	62	118
AC Electronics I	26	40	66
	82	102	184
Semester III			
AC Electronics II	36	19	55
Semiconductors	39	45	84
Vacuum Tubes	8	18	26
	83	82	165
Semester IV			
Electronics Circuits I	68	138	206
	68	138	206
Semester V			
Servicing Components	32	88	120
Television I	16	36	52
	48	124	172
Semester VI			
Television II	57	125	182
	57	125	182
Semester VII			
Television III	12	36	48
TV Color Section	27	63	90
	39	99	138
Total Program Hours	405	822	1227

*This curriculum structure is designed to be used for group instruction.

ELECTRONICS CLUSTER SUGGESTED CURRICULUM STRUCTURE*

ORIENTATION
- School Policies and Procedures
- Program Orientation and Safety
- Operation of Audiovisual Equipment
- Using the Learning Resource Center

BASIC SKILLS
- Introduction to DC Electronics
- DC Electronics
- AC Electronics I
- AC Electronics II
- Semiconductors
- Vacuum Tubes
- Electronics Circuits I
- Servicing Components
- Television I
- Television II
- Television III
- TV Color Section

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*This curriculum structure is designed to be used for individualized instruction in either a quarter system or semester system.

INTRODUCTION TO ELECTRONICS CLUSTER
EXIT POINTS

The following diagrams illustrate points in the Electronics Cluster program where a student should have acquired competencies necessary for entry level employment.

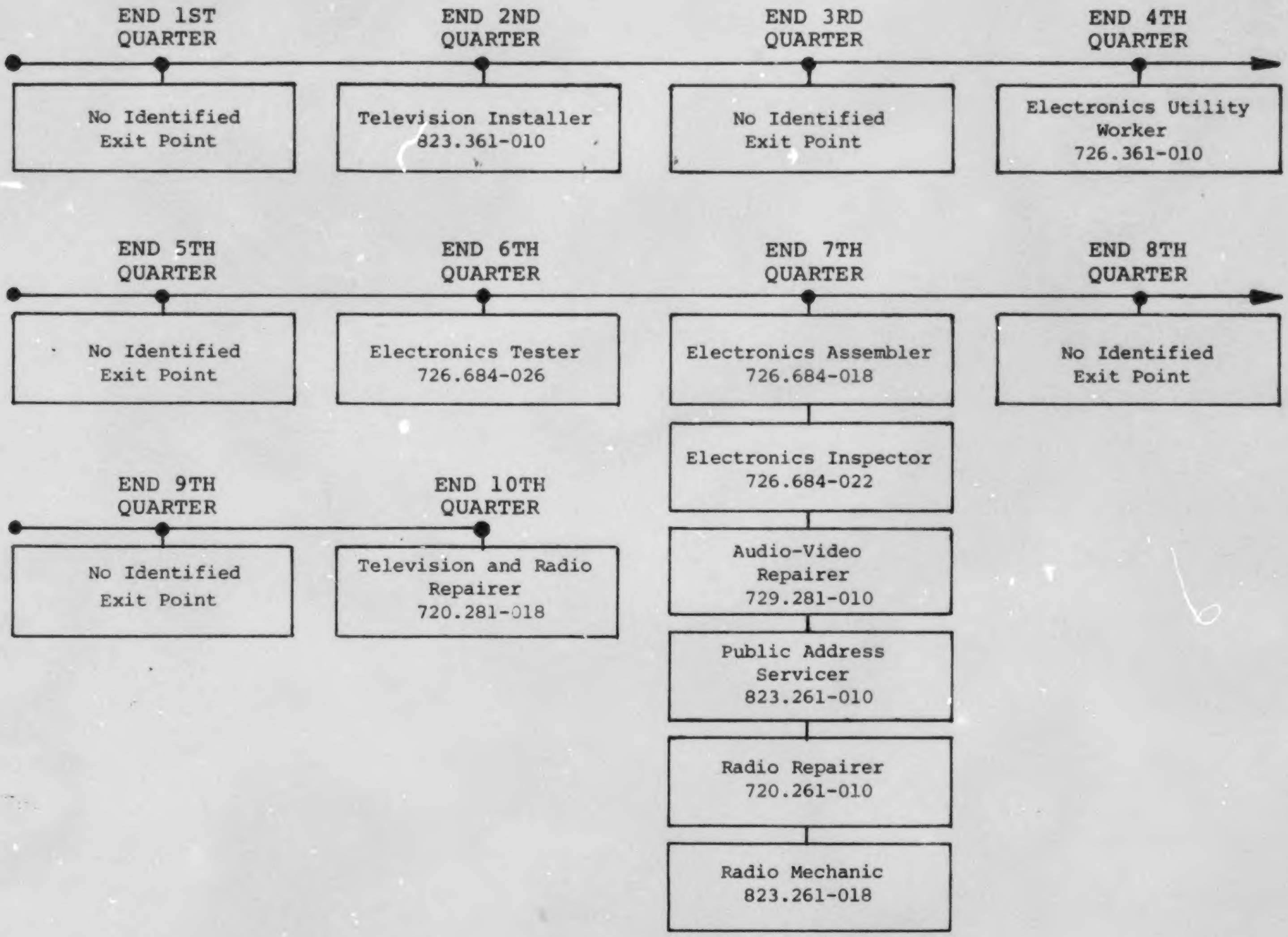
Both the group and individualized exit point diagrams sequence the Electronics Cluster job classifications from least to most difficult. The group exit point diagram illustrates a lock-step process in which students proceed through an entire program at the same pace and exit at approximately the same point in time.

The individualized exit point diagram illustrates a self-paced progression through the Electronics Cluster program. This approach permits a student to complete any one or all tasks necessary for entry level employment.

The major difference between the group and individualized approach is the number of tasks a student must master. For example, in the individualized approach, a student desiring employment as a television and radio repairer needs to complete only those tasks identified for that job. However, in the group approach, a student must master the tasks in the previous DOT classifications leading to that particular job title.

Both diagrams are based on the preceeding suggested curriculum structures.

ELECTRONICS CLUSTER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END 2ND QUARTER
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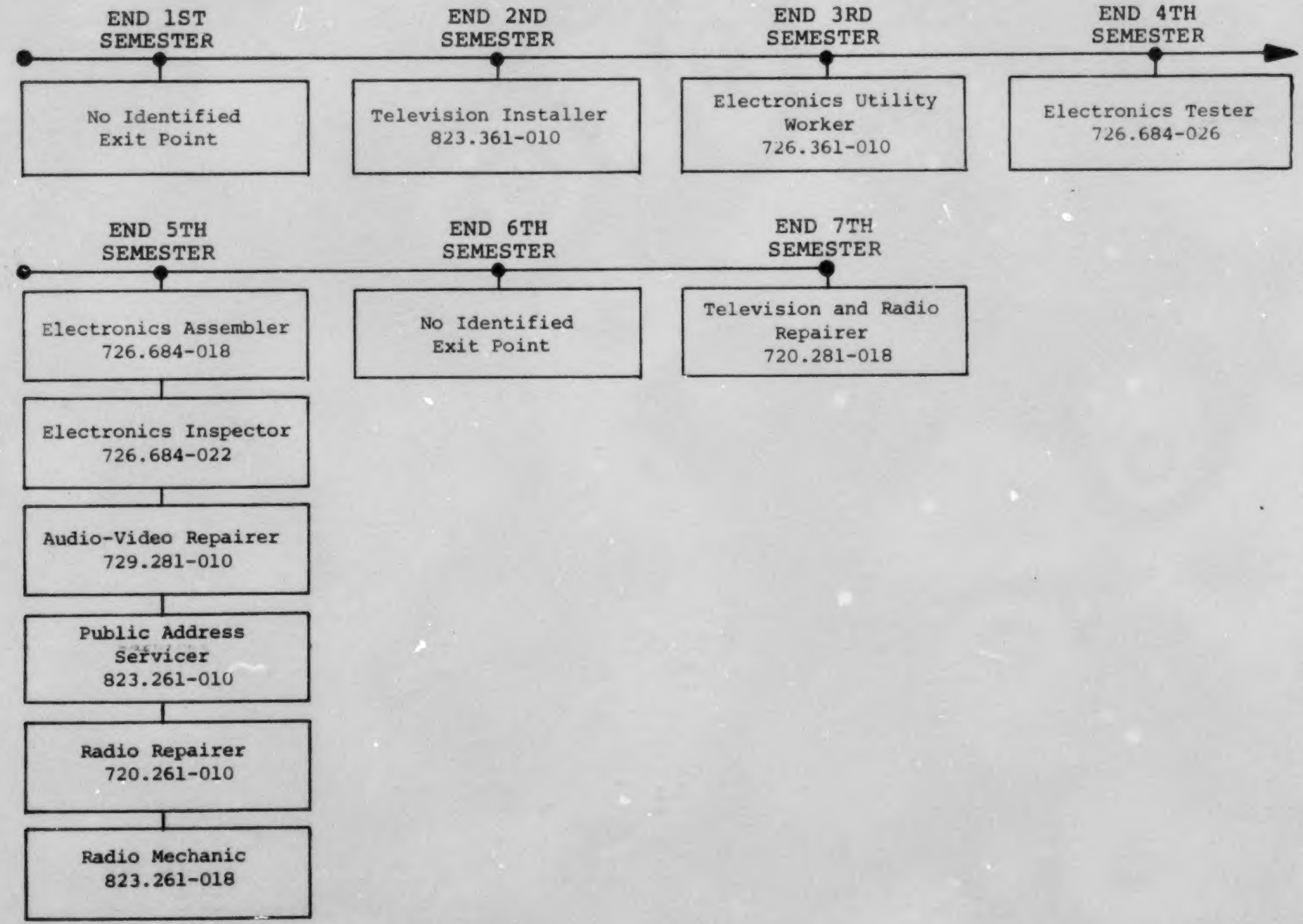
END 3RD QUARTER
No Identified Exit Point
END 4TH QUARTER
Electronics Utility Worker 726.361-010
END 5TH QUARTER
No Identified Exit Point
END 6TH QUARTER
Electronics Tester 726.684-026
END 7TH QUARTER
Electronics Assembler 726.684-018
Electronics Inspector 726.684-022
Audio-Video Repairer 729.281-010
Public Address Servicer 823.261-010
Radio Repairer 720.261-010
Radio Mechanic 823.261-018
END 8TH QUARTER
No Identified Exit Point
END 9TH QUARTER
No Identified Exit Point
END 10TH QUARTER
Television and Radio Repairer 720.281-018

ELECTRONICS CLUSTER
(Group Instruction)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No Identified Exit Point
END 2ND SEMESTER
Television Installer 823.361-010
END 3RD SEMESTER
Electronics Utility Worker 726.361-010
END 4TH SEMESTER
Electronics Tester 726.684-026
END 5TH SEMESTER
Electronics Assembler 726.684-018
Electronics Inspector 726.684-022
Audio-Video Repairer 729.281-010
Public Address Servicer 823.261-010
Radio Repairer 720.261-010
Radio Mechanic 823.261-018
END 6TH SEMESTER
No Identified Exit Point
END 7TH SEMESTER
Television and Radio Repairer 720.281-018

ELECTRONICS CLUSTER

(Individualized Instruction)

Television Installer
823.361-010

Electronics Utility Worker
726.361-010

Electronics Tester
726.684-026

Electronics Assembler
726.684-018

Electronics Inspector
726.684-022

Audio-Video Repairer
729.281-010

Public Address Servicer
823.261-010

Radio Repairer
720.261-010

Radio Mechanic
823.261-018

Television and Radio Repairer
720.281-018

INTRODUCTION TO THE COURSE OUTLINE

A course outline suggests a method of sequencing tasks for instruction. In the following outline, the unit guide tasks are ordered according to duty areas. The tasks are then arranged from general to specific knowledge and applications. The instructor is not restricted to using this specific outline, but may adapt it to meet his or her teaching needs.

The following course outline is designed for group instruction, however, it may be adapted for individualized instruction by eliminating the time sequencing for tasks.

ELECTRONICS CLUSTER SUGGESTED COURSE OUTLINE

Quarter I

Task	Title	Class Hours	Lab Hours
	BASIC SKILLS		
BS-01	Observing electrical safety precautions and first aid practices	2	4
BS-02	Using hand tools	1	5
BS-03	Using power tools	1	11
BS-04	Soldering to terminals and PC boards	2	8
BS-05	Selecting, preparing and installing wiring	2	14
BS-06	Installing coaxial connectors	0	6
BS-07	Performing a visual inspection of electronic equipment	0	10
BS-08	Cleaning electronic equipment	0	12
BS-09	Lubricating electronic equipment	0	18
BS-10	Inspecting and replacing power cords and distribution cables	0	12
BS-11	Keeping records on maintenance of equipment	6	18
	Total Course Hours	14	118
	Total Quarter I Class and Lab Hours	14	118
	Total Quarter I Instructional Hours	132	

Quarter II

Task	Title	Class Hours	Lab Hours
	ELECTRONIC PARTS		
BS-12	Preparing parts lists	6	24
	Total Course Hours	6	24
	DC ELECTRONICS I		
DC-01	Understanding fundamentals of electrical theory and electrical measurement	8	4
DC-02	Using volt-ohm milliammeters	0	6
DC-03	Using electronic voltmeters (EVM)	0	6
DC-04	Measuring current in DC circuits	4	2
DC-05	Measuring voltage in DC circuits	4	2
DC-06	Calculating and measuring resistance in DC circuits	3	9
DC-07	Making calculations using Ohm's law	6	0
DC-08	Calculating voltage, current and resistance in DC series circuits	6	6
DC-09	Calculating total voltage, total current and total resistance	6	6
DC-10	Calculating and measuring electrical quantities in combination DC circuits	6	6
	Total Course Hours	43	47
	Total Quarter II Class and Lab Hours	49	71
	Total Quarter II Instructional Hours	120	

Quarter III

Task	Title	Class Hours	Lab Hours
	DC ELECTRONICS II		
DC-11	Calculating power in DC circuits	4	2
DC-12	Applying fundamentals of magnetism and electromagnetism	3	3
DC-13	Analyzing and modifying meter movements	4	10
DC-14	Calculating values in DC network circuits	4	6
DC-15	Calculating capaitance and time constants for RC circuits	6	4
	Total Course Hours	21	25
	AC ELECTRONICS I		
AC-01	Calculating values for a right triangle	6	0
AC-02	Using oscilloscopes	2	10
AC-03	Analyzing AC sine waves	3	3
AC-04	Measuring AC values for LF circuits	4	2
AC-05	Determining reactance and impedance of capacitors in series and parallel circuits	5	1
AC-06	Using capacitor testers	0	6
AC-07	Calculating and measuring electrical values in AC capacitance circuits	4	8
AC-08	Using impedance testers	2	10
AC-09	Measuring inductance in series and parallel RL circuits	6	6
	Total Course Hours	32	46

Total Quarter III Class and Lab Hours 53 71
Total Quarter III Instructional Hours 124

Quarter IV

Task	Title	Class Hours	Lab Hours
	AC ELECTRONICS II		
AC-10	Computing turns, voltage, current and impedance ratios of transformers	12	0
AC-11	Drawing phasor diagrams and calculating operating values for series AC circuits	9	3
AC-12	Drawing phasor diagrams and calculating operating values for parallel AC circuits	6	6
AC-13	Analyzing tuned AC circuits	3	4
	Total Course Hours	30	13
	SEMICONDUCTORS		
SC-01	Analyzing the characteristics and functions of semiconductors	6	6
SC-02	Analyzing the application and operation of semiconductor diodes	3	3
SC-03	Analyzing the application and operation of zener diodes in regulator circuits	4	8
SC-04	Analyzing the application and operation of tunnel, varactor and high frequency diodes	3	3
SC-05	Analyzing the operation of bipolar transistors	6	12
SC-06	Analyzing the operation of field effect transistors	3	3
SC-07	Analyzing the operation of thyristors	6	6
SC-08	Analyzing the operation of integrated circuits	6	0
SC-09	Analyzing the operation of optoelectronic devices	2	4
	Total Course Hours	39	45
	Total Quarter IV Class and Lab Hours	69	58
	Total Quarter IV Instructional Hours	127	

Quarter V

Task	Title	Class Hours	Lab Hours
	VACUUM TUBES		
VT-01	Analyzing the operation of diode vacuum tubes	2	2
VT-02	Analyzing the operation of triode vacuum tubes	2	2
VT-03	Analyzing the operation of tetrode vacuum tubes	2	2
VT-04	Analyzing the operation of pentode vacuum tubes	2	2
VT-05	Inspecting and replacing vacuum tubes	0	10
	Total Course Hours	8	18
	ELECTRONIC CIRCUITS I		
EC-01	Analyzing common emitter amplifier circuits	3	9
EC-02	Analyzing the operation of DC and audio amplifiers	2	10
EC-03	Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers	6	18
EC-04	Testing amplifiers for amplification	3	3
EC-05	Testing and repairing vacuum tube amplifiers	2	4
EC-06	Testing and repairing transistor amplifiers	2	4
EC-07	Analyzing power supply circuits	4	8
EC-08	Testing and repairing power supplies	2	4
EC-09	Calibrating power supply voltage	2	4
	Total Course Hours	26	64

Total Quarter V Class and Lab Hours 34 82
Total Quarter V Instructional Hours 116

Quarter VI

Task	Title	Class Hours	Lab Hours
	ELECTRONIC CIRCUITS II		
EC-10	Analyzing the operation of oscillators	4	8
EC-11	Testing and repairing oscillators	4	8
EC-12	Testing and repairing counter circuits	4	8
EC-13	Analyzing pulse circuits	6	6
EC-14	Testing and repairing nonsinusoidal amplifiers	4	8
EC-15	Analyzing amplitude modulator (AM) circuits	8	12
EC-16	Analyzing frequency modulator (FM) circuits	6	12
EC-17	Analyzing the operation of superheterodyne receivers	6	12
	Total Course Hours	42	74
	Total Quarter VI Class and Lab Hours	42	74
	Total Quarter VI Instructional Hours	116	

Quarter VII

Task	Title	Class Hours		Lab Hours
	SERVICING COMPONENTS			
EC-18	Servicing tape recorders	6		12
EC-19	Servicing record changers	6		12
EC-20	Inspecting and repairing loudspeakers	4		8
EC-21	Inspecting and repairing microphones	4		8
EC-22	Laying out, taping up and drawing basic printed circuit boards	6		24
EC-23	Constructing printed circuit (PC) boards	6		24
	Total Course Hours	32		88
	Total Quarter VII Class and Lab Hours	32		88
	Total Quarter VII Instructional Hours		120	

Quarter VIII

Task	Title	Class Hours		Lab Hours
	TELEVISION I			
TV-01	Analyzing the stages of a black and white TV receiver	6		12
TV-02	Analyzing low voltage power supplies	6		12
TV-03	Troubleshooting switch-mode secondary voltage supplies	4		12
TV-04	Troubleshooting synchronizing and deflection circuits	6		12
TV-05	Troubleshooting horizontal output circuits	6		12
TV-06	Troubleshooting sweep-generator circuits	6		12
TV-07	Troubleshooting high voltage supplies	6		12
	Total Course Hours	40		84
	Total Quarter VIII Class and Lab Hours	40		84
	Total Quarter VIII Instructional Hours		124	

Quarter IX

Task	Title	Class Hours		Lab Hours
	TELEVISION II			
TV-08	Aligning the CRT and associated circuits	2		10
TV-09	Troubleshooting vertical deflection circuits	0		16
TV-10	Adjusting the purity, focus and gray scale to produce a normal raster	0		8
TV-11	Analyzing the operation of video amplifiers	14		0
TV-12	Troubleshooting defective video amplifiers	0		12
TV-13	Analyzing video IF amplifiers	6		6
TV-14	Aligning RF and IF amplifiers	4		8
TV-15	Analyzing the operation of sound IF and AM circuits	4		8
TV-16	Aligning sound IF and AM circuits	3		9
	Total Course Hours	33		77
	Total Quarter IX Class and Lab Hours	33		77
	Total Quarter IX Instructional Hours		110	

Quarter X

Task	Title	Class Hours		Lab Hours
	TELEVISION III			
TV-17	Analyzing VHF and UHF tuner circuits	4		12
TV-18	Analyzing automatic fine tuning (AFT) and remote control circuits	4		12
TV-19	Analyzing automatic gain control (AGC) and noise canceling circuits	4		12
	Total Course Hours	12		36
	TV COLOR SECTION			
TV-20	Analyzing color television signal reception and decoding	6		6
TV-21	Testing picture tubes and associated circuits	3		9
TV-22	Analyzing band-pass amplifiers, color killer circuits and automatic color control circuits	3		9
TV-23	Analyzing color sync circuits	3		9
TV-24	Analyzing color demodulator and output amplifier circuits	3		9
TV-25	Troubleshooting defective color tuning circuits	6		12
TV-26	Analyzing and adjusting color convergence circuits	3		9
	Total Course Hours	27		63
	Total Quarter X Class and Lab Hours	39		99
	Total Quarter X Instructional Hours		138	
	Total Program Instructional Hours		1227	

ELECTRONICS CLUSTER SUGGESTED COURSE OUTLINE

Semester I

Task	Title	Class Hours	Lab Hours
	Basic Skills		
BS-01	Observing electrical safety precautions and first aid practice	2	4
BS-02	Using hand tools	1	5
BS-03	Using power tools	1	11
BS-04	Soldering to terminals and PC boards	2	8
BS-05	Selecting, preparing and installing wiring	2	14
BS-06	Installing coaxial connectors	0	6
BS-07	Performing a visual inspection of electronic equipment	0	10
BS-08	Cleaning electronic equipment	0	12
BS-09	Lubricating electronic equipment	0	18
BS-10	Inspecting and replacing power cords and distribution cables	0	12
BS-11	Keeping records on maintenance of equipequipment	6	18
BS-12	Preparing parts lists	6	24
	Total Course Hours	20	142
	Introduction to DC Electronics		
DC-01	Understanding fundamentals of electrical theory and electrical measurement	8	4
DC-02	Using volt-ohm milliammeters	0	6
	Total Course Hours	8	10
	Total Semester I Class and Lab Hours	28	152
	Total Semester I Instructional Hours	180	

Semester II

Task	Title	Class Hours	Lab Hours
	DC Electronics		
DC-03	Using electronic voltmeters (EVM)	0	6
DC-04	Measuring current in DC circuits	4	2
DC-05	Measuring voltage in DC circuits	4	2
DC-06	Calculating and measuring resistance in DC circuits	3	9
DC-07	Making calculations using Ohm's law	6	0
DC-08	Calculating voltage, current and resistance in DC series circuits	6	6
DC-09	Calculating total voltage, total current and total resistance	6	6
DC-10	Calculating and measuring electrical quantities in combination DC circuits	6	6
DC-11	Calculating power in DC circuits	4	2
DC-12	Applying fundamentals of magnetism and electromagnetism	3	3
DC-13	Analyzing and modifying meter movements	4	10
DC-14	Calculating values in DC network circuits	4	6
DC-15	Calculating capacitance and time constants for RC circuits	6	4
	Total Course Hours	56	62
	AC Electronics I		
AC-01	Calculating values for a right triangle	6	0
AC-02	Using oscilloscopes	2	10
AC-03	Analyzing AC sine waves	3	3
AC-04	Measuring AC values for LF circuits	4	2
AC-05	Determining reactance and impedance of capacitors in series and parallel circuits	5	1
AC-06	Using capacitor testers	0	6
AC-07	Calculating and measuring electrical values in AC capacitance circuits	4	8
AC-08	Using impedance testers	2	10
	Total Course Hours	26	40
	Total Semester II Class and Lab Hours	82	102
	Total Semester II Instructional Hours	184	

Semester III

Task	Title	Class Hours	Lab Hours
	AC Electronics II		
AC-09	Measuring inductance in series and parallel RL circuits	6	6
AC-10	Computing turns, voltage, current and impedance ratios of transformers	12	0
AC-11	Drawing phasor diagrams and calculating operating values for series AC circuits	9	3
AC-12	Drawing phasor diagrams and calculating operating values for parallel AC circuits	6	6
AC-13	Analyzing tuned AC circuits	3	4
	Total Course Hours	36	19
	Semiconductors		
SC-01	Analyzing the characteristics and functions of semiconductors	6	6
SC-02	Analyzing the application and operation of semiconductor diodes	3	3
SC-03	Analyzing the application and operation of zener diodes in regulator circuits	4	8
SC-04	Analyzing the application and operation of tunnel, varactor and high frequency diodes	3	3
SC-05	Analyzing the operation of bipolar transistors	6	12
SC-06	Analyzing the operation of field effect transistors	3	3
SC-07	Analyzing the operation of thyristors	6	6
SC-08	Analyzing the operation of integrated circuits	6	0
SC-09	Analyzing the operation of optoelectronic devices	2	4
	Total Course Hours	39	45
	Vacuum Tubes		
VT-01	Analyzing the operation of diode vacuum tubes	2	2
VT-02	Analyzing the operation of triode vacuum tubes	2	2
VT-03	Analyzing the operation of tetrode vacuum tubes	2	2
VT-04	Analyzing the operation of pentode vacuum tubes	2	2
VT-05	Inspecting and replacing vacuum tubes		10
	Total Course Hours	8	18
	Total Semester III Class and Lab Hours	83	82
	Total Semester III Instructional Hours	165	

Semester IV

Task	Title	Class Hours	Lab Hours
	Electronic Circuits I		
EC-01	Analyzing common emitter amplifier circuits	3	9
EC-02	Analyzing the operation of DC and audio amplifiers	2	10
EC-03	Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers	6	18
EC-04	Testing amplifiers for amplification	3	3
EC-05	Testing and repairing vacuum tube amplifiers	2	4
EC-06	Testing and repairing transistor amplifiers	2	4
EC-07	Analyzing power supply circuits	4	8
EC-08	Testing and repairing power supplies	2	4
EC-09	Calibrating power supply voltage	2	4
EC-10	Analyzing the operation of oscillators	4	8
EC-11	Testing and repairing oscillators	4	8
EC-12	Testing and repairing counter circuits	4	8
EC-13	Analyzing pulse circuits	6	6
EC-14	Testing and repairing nonsinusoidal amplifiers	4	8
EC-15	Analyzing amplitude modulator (AM) circuits	8	12
EC-16	Analyzing frequency modulator (FM) circuits	6	12
EC-17	Analyzing the operation of superheterodyne receivers	6	12
	Total Course Hours	68	138
	Total Semester IV Class and Lab Hours	68	138
	Total Semester IV Instructional Hours	206	

Semester V

Task	Title	Class Hours	Lab Hours
	Servicing Components		
EC-18	Servicing tape recorders	6	12
EC-19	Servicing record changers	6	12
EC-20	Inspecting and repairing loudspeakers	4	8
EC-21	Inspecting and repairing microphones	4	8
EC-22	Laying out, taping up and drawing basic printed circuit boards	6	24
EC-23	Constructing printed circuit (PC) boards	6	24
	Total Course Hours	32	88
	Television I		
TV-01	Analyzing the stages of a black and white TV receiver	6	12
TV-02	Analyzing low voltage power supplies	6	12
TV-03	Troubleshooting switch-mode secondary voltage supplies	4	12
	Total Course Hours	16	36
	Total Semester V Class and Lab Hours	48	124
	Total Semester V Instructional Hours	172	

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Semester VI

Task	Title	Class Hours	Lab Hours
	Television II		
TV-04	Troubleshooting synchronizing and deflection circuits	6	12
TV-05	Troubleshooting horizontal output circuits	6	12
TV-06	Troubleshooting sweep-generator circuits	6	12
TV-07	Troubleshooting high voltage supplies	6	12
TV-08	Aligning the CRT and associated circuits	2	10
TV-09	Troubleshooting vertical deflection circuits	0	16
TV-10	Adjusting the purity, focus and gray scale to produce a normal raster	0	8
TV-11	Analyzing the operation of video amplifiers	14	0
TV-12	Troubleshooting defective video amplifiers	0	12
TV-13	Analyzing video IF amplifiers	6	6
TV-14	Aligning RF and IF amplifiers	4	8
TV-15	Analyzing the operation of sound IF and AM circuits	4	8
TV-16	Aligning sound IF and AM circuits	3	9
	Total Course Hours	57	125

Total Semester VI Class and Lab Hours 57 125
Total Semester VI Instructional Hours 182

Semester VII

Task	Title	Class Hours	Lab Hours
	Television III		
TV-17	Analyzing VHF and UHF tuner circuits	4	12
TV-18	Analyzing automatic fine tuning (AFT) and remote control circuits	4	12
TV-19	Analyzing automatic gain control (AGC) and noise canceling circuits	4	12
	Total Course Hours	12	36
	TV Color Section		
TV-20	Analyzing color television signal reception and decoding	6	6
TV-21	Testing picture tubes and associated circuits	3	9
TV-22	Analyzing band-pass amplifiers, color killer circuits and automatic color control circuits	3	9
TV-23	Analyzing color sync circuits	3	9
TV-24	Analyzing color demodulator and output amplifier circuits	3	9
TV-25	Troubleshooting defective color tuning circuits	6	12
TV-26	Analyzing and adjusting color convergence circuits	3	9
	Total Course Hours	27	63
	Total Semester VII Class and Lab Hours	39	99
	Total Semester VII Instructional Hours	138	
	Total Program Hours	1227	

SECTION V

RECORDS

SECTION V

Section V Content List

Individualized Competency Record
Group Progress Chart

Section V presents suggested ways of recording and documenting the progress of students through the curriculum. The recommended procedures include options for both individual and group records. The very important function of communicating the student's qualifications to potential employers is handled clearly and efficiently by the use of the Certificate of Competency, which is also described in this section.

RECORDS MANAGEMENT

This guide provides a series of easy to use documents that will aid the instructor in recordkeeping and that will be beneficial to the student in entering the work force.

In addition to providing the instructor with an "at a glance" assessment of individual and/or group progress, a Certificate of Competency, which can be used by students seeking employment, is included.

The group progress chart reflects individual task completion of all students. Due to confidentiality of records, grades must not be recorded on the chart. A notation indicating task completion (i.e., x or check) should be used.

INSTRUCTIONS

Instructions

Competency Checklist

1) Enter the student's name.
2) Enter the date and instructor's initials as each unit of instruction is completed.

The Competency Checklist automatically indicates when all the requirements for each DOT exit point or job title have been completed by the student. At each point on the certificate where an asterisk appears, the student is eligible to receive a Certificate of Competency.

Certificate of Competency

A Certificate of Competency is to be issued for each job title for which a student is qualified.

1) Enter the student's name.
2) Enter the school's name
3) Sign and date the form.

A Certificate of Competency may be issued at the time a student qualifies for it, or all certificates for which a student qualifies may be issued to the student when he/she completes or leaves the program.

Group Progress Chart

1) Enter all program tasks across top of matrix.
2) Enter the students' names down the left hand side of matrix.
3) As each student completes a task, a notation should be made in the square which corresponds with the task and the student's name.

COMPETENCY CHECKLIST

PROGRAM: ELECTRONICS CLUSTER

STUDENT NAME: ______________________________

				EXIT POINTS									
				JOB TITLE Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer
TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	DOT NO. 726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010
	Basic Skills												
BS-01	Observing electrical safety precautions and first aid procedures			X	X	X	X	X	X	X	X	X	X
BS-02	Using hand tool			X	X	X	X	X	X	X	X	X	X
BS-03	Using power tools			X	X	X	X	X	X	X	X	X	X
BS-04	Soldering to terminals and PC boards			X	X	X	X	X	X	X	X	X	X
BS-05	Selecting, preparing and installing wiring			X	X	X	X	X	X	X	X	X	X
BS-06	Installing coaxial connectors			X	X	X	X	X	X	X	X	X	X
BS-07	Performing a visual inspection of electronic equipment			X	X	X	X	X	X	X	X	X	X
BS-08	Cleaning electronic equipment			X	X	X	X	X	X	X	X	X	X
BS-09	Lubricating electronic equipment			X	X	X	X	X	X	X	X	X	X
BS-10	Inspecting and replacing power cords and distribution cables			X	X	X	X	X	X	X	X	X	X
BS-11	Keeping records on maintenance of equipment			X	X	X	X	X	X	X	X	X	X
BS-12	Preparing parts lists			X	X	X	X	X	X	X	X	X	
	DC Electronics												
DC-01	Understanding fundamentals of electrical theory and electrical measurement			X	X	X	X	X	X	X	X	X	X
DC-02	Using volt-ohm milliammeters (VOM)			X	X	X	X	X	X	X	X	X	X
DC-03	Using electronic voltmeters (EVM)			X	X	X	X	X	X	X	X	X	X
DC-04	Measuring current in DC circuits			X	X	X	X	X	X	X	X	X	X
DC-05	Measuring voltage in DC circuits			X	X	X	X	X	X	X	X	X	X
DC-06	Calculating and measuring resistance in DC circuits			X	X	X	X	X	X	X	X	X	*X
DC-07	Making calculations using Ohm's law			X	X	X	X	X	X	X	X	X	
DC-08	Calculating voltage, current and resistance in DC series circuits			X	X	X	X	X	X	X	X	X	
DC-09	Calculating total voltage, total current and total resistance			X	X	X	X	X	X	X	X	X	
DC-10	Calculating and measuring electrical quantities in combination DC circuits			X	X	X	X	X	X	X	X	X	
DC-11	Calculating power in DC circuits			X	X	X	X	X	X	X	X	X	
DC-12	Applying fundamentals of magnetism and electromagnetism			X	X	X	X	X	X	X	X	X	
DC-13	Analyzing and modifying meter movements			X	X	X	X	X	X	X	X	X	
DC-14	Calculating values in DC network circuits					X	X	X	X	X	X	X	
DC-15	Calculating capacitance and time constants for RC circuits					X	X	X	X	X	X	X	
	AC Electronics												
AC-01	Calculating values for a right triangle					X	X	X	X	X	X	X	
AC-02	Using oscilloscopes					X	X	X	X	X	X	X	
AC-03	Analyzing AC sine waves					X	X	X	X	X	X	X	
AC-04	Measuring AC values for LF circuits					X	X	X	X	X	X	X	
AC-05	Determining reactance and impedance of capacitors in series and parallel circuits					X	X	X	X	X	X	X	
AC-06	Using capacitor testers					X	X	X	X	X	X	X	
AC-07	Calculating and measuring electrical values in AC capacitance circuits					X	X	X	X	X	X	X	
AC-08	Using impedance testers					X	X	X	X	X	X	X	
AC-09	Measuring inductance in series and parallel RL circuits					X	X	X	X	X	X	X	
AC-10	Computing turns, voltage, current and impedance ratios of transformers			X		X	X	X	X	X	X	X	

COMPETENCY CHECKLIST

PROGRAM: ELECTRONICS CLUSTER

STUDENT NAME: ______________________________

EXIT POINTS

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	JOB TITLE	Electronics Utility Worker	Electronics Assembler	Electronics Inspector	Electronics Tester	Audio-Video Repairer	Public Address Servicer	Radio Repairer	Radio Mechanic	Television and Radio Repairer	Television Installer
				DOT NO.	726.361-010	726.684-018	726.684-022	726.684-026	729.281-010	823.261-010	720.281-010	823.261-018	720.281-018	823.361-010
AC-11	Drawing phasor diagrams and calculating operating values for series AC circuits						X	X	X	X	X	X	X	
AC-12	Drawing phasor diagrams and calculating operating values for parallel AC circuits						X	X	X	X	X	X	X	
AC-13	Analyzing tuned AC circuits						X	X	X	X	X	X	X	
	Semiconductors													
SC-01	Analyzing the characteristics and functions of semiconductors				X	X	X	X	X	X	X	X	X	
SC-02	Analyzing the application and operation of semiconductor diodes				X	X	X	X	X	X	X	X	X	
SC-03	Analyzing the application and operation of zener diodes in regulator circuits				X	X	X	X	X	X	X	X	X	
SC-04	Analyzing the application and operation of tunnel, varactor and high frequency diodes				X	X	X	X	X	X	X	X	X	
SC-05	Analyzing the operation of bipolar transistors				*X	X	X	X	X	X	X	X	X	
SC-06	Analyzing the operation of field effect transistors						X	X	X	X	X	X	X	
SC-07	Analyzing the operation of thyristors						X	X	X	X	X	X	X	
SC-08	Analyzing the operation of integrated circuits						X	X	X	X	X	X	X	
SC-09	Analyzing the operation of optoelectronic devices						X	X	X	X	X	X	X	
	Vacuum Tubes													
VT-01	Analyzing the operation of diode vacuum tubes						X	X	X	X	X	X	X	
VT-02	Analyzing the operation of triode vacuum tubes						X	X	X	X	X	X	X	
VT-03	Analyzing the operation of tetrode vacuum tubes						X	X	X	X	X	X	X	
VT-04	Analyzing the operation of pentode vacuum tubes						X	X	X	X	X	X	X	
VT-05	Inspecting and replacing vacuum tubes						X	X	X	X	X	X	X	
	Electronic Circuits I													
EC-01	Analyzing common emitter amplifier circuits						X	X	X	X	X	X	X	
EC-02	Analyzing the operation of DC and audio amplifiers						X	X	X	X	X	X	X	
EC-03	Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers						X	X	X	X	X	X	X	
EC-04	Testing amplifiers for amplification						X	X	X	X	X	X	X	
EC-05	Testing and repairing vacuum tube amplifiers						X	X	X	X	X	X	X	
EC-06	Testing and repairing transistor amplifiers						X	X	X	X	X	X	X	
EC-07	Analyzing power supply circuits						X	X	X	X	X	X	X	
EC-08	Testing and repairing power supplies						X	X	X	X	X	X	X	
EC-09	Calibrating power supply voltage						X	X	X	X	X	X	X	
	Electronic Circuits II													
EC-10	Analyzing the operation of oscillators						X	X	X	X	X	X	X	
EC-11	Testing and repairing oscillators						X	X	X	X	X	X	X	
EC-12	Testing and repairing counter circuits						X	X	X	X	X	X	X	
EC-13	Analyzing pulse circuits						X	X	X	X	X	X	X	
EC-14	Testing and repairing nonsinusoidal amplifiers						X	X	X	X	X	X	X	
EC-15	Analyzing amplitude modulator (AM) circuits						X	X	X	X	X	X	X	
EC-16	Analyzing frequency modulator (FM) circuits						X	X	X	X	X	X	X	
EC-17	Analyzing the operation of superheterodyne receivers						X	*X	X	X	X	X	X	
	Servicing Components													
EC-18	Servicing tape recorders								X	X	X	X	X	
EC-19	Servicing record changers								X	X	X	X	X	
EC-20	Inspecting and repairing loudspeakers								X	X	X	X	X	

COMPETENCY CHECKLIST

PROGRAM: ELECTRONICS CLUSTER

STUDENT NAME:____________________________________

EXIT POINTS

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	JOB TITLE / DOT NO.: Electronics Utility Worker 726.361-010	Electronics Assembler 726.684-018	Electronics Inspector 726.684-022	Electronics Tester 726.684-026	Audio-Video Repairer 729.281-010	Public Address Servicer 823.261-010	Radio Repairer 720.261-010	Radio Mechanic 823.261-018	Television and Radio Repairer 720.281-018	Television Installer 823.361-010
EC-21	Inspecting and repairing microphones							X	X	X	X	X	
EC-22	Laying out, taping up and drawing basic printed circuit boards				X	X		X	X	X	X	X	
EC-23	Constructing printed circuit (PC) boards				*X	*X		*X	*X	*X	*X	X	
	Television I												
TV-01	Analyzing the stages of a black and white TV receiver											X	
TV-02	Analyzing low voltage power supplies											X	
TV-03	Troubleshooting switch-mode secondary voltage supplies											X	
TV-04	Troubleshooting synchronizing and deflection circuits											X	
	Television II												
TV-05	Troubleshooting horizontal output circuits											X	
TV-06	Troubleshooting sweep-generator circuits											X	
TV-07	Troubleshooting high voltage supplies											X	
TV-08	Aligning the CRT and associated circuits											X	
TV-09	Troubleshooting vertical deflection circuits											X	
TV-10	Adjusting the purity, focus and gray scale to produce a normal raster											X	
TV-11	Analyzing the operation of video amplifiers											X	
TV-12	Troubleshooting defective video amplifiers											X	
TV-13	Analyzing video IF amplifiers											X	
TV-14	Aligning RF and IF amplifiers											X	
TV-15	Analyzing the operation of sound IF and AM circuits											X	
TV-16	Aligning sound IF and AM circuits											X	
TV-17	Analyzing VHF and UHF tuner circuits											X	
TV-18	Analyzing automatic fine tuning (AFT) and remote control circuits											X	
TV-19	Analyzing automatic gain control (AGC) and noise canceling circuits											X	
	TV Color Section												
TV-20	Analyzing color television signal reception and decoding											X	
TV-21	Testing picture tubes and associated circuits											X	
TV-22	Analyzing band-pass amplifiers, color killer circuits and automatic color control circuits											X	
TV-23	Analyzing color sync circuits											X	
TV-24	Analyzing color demodulator and output amplifier circuits											X	
TV-25	Troubleshooting defective color tuning circuits											X	
TV-26	Analyzing and adjusting color convergence circuits											*X	

This is to certify that the above named student has demonstrated proficiency in the performance of the competencies and/or tasks indicated above. These competencies and/or tasks have been determined to be the skills and knowledge that are necessary for entry level employment into the job classifcations indicated.

Date____________Instructor________________________
School________________________
Instructor________________________
Instructor________________________
Instructor________________________
Instructor________________________

*Certificate of Competency can be issued

CERTIFICATE OF COMPETENCY

This is to Certify that

Bill Dobson

SAMPLE

of

North Georgia Tech

has successfully mastered the competencies required to perform the job of

INSTALLER

Bruce Giles

October 7, 1981

V-11

321

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Installer.

INSTALLER
(D.O.T. Code 823.361-010)

Basic Skills
Observing electrical safety precautions and first aid practices
Using hand tools
Using power tools
Soldering to terminals and PC boards
Selecting, preparing and installing wiring
Installing coaxial connectors
Performing a visual inspection of electronic equipment
Cleaning electronic equipment
Inspecting and replacing power cords and distribution cables
Keeping records on maintenance of equipment
Preparing parts lists

DC Electronics
Understanding fundamentals of electrical theory and electrical measurement
Using volt-ohm milliammeters (VOM)
Using electronic voltmeters (EVM)
Measuring current in DC circuits
Measuring voltage in DC circuits
Calculating and measuring resistance in DC circuits

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

____

has successfully mastered the competencies required to perform the job of

ELECTRONICS UTILITY WORKER

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Electronics Utility Worker.

ELECTRONICS UTILITY WORKER
(D.O.T. Code 726.361-010)

Basic Skills

Observing electrical safety precautions and first aid practices
Using hand tools
Using power tools
Soldering to terminals and PC boards
Selecting, preparing and installing wiring
Installing coaxial connectors
Performing a visual inspection of electronic equipment
Cleaning electronic equipment
Lubricating electronic equipment
Inspecting and replacing power cords and distribution cables
Keeping records on maintenance of equipment
Preparing parts lists

DC Electronics

Understanding fundamentals of electrical theory and electrical measurement
Using volt-ohm milliammeters (VOM)
Using electronic voltmeters (EVM)
Measuring current in DC circuits
Measuring voltage in DC circuits
Calculating and measuring resistance in DC circuits
Making calculations using Ohm's law
Calculating voltage, current and resistance in DC series circuits
Calculating total voltage, total current and total resistance
Calculating and measuring electrical quantities in combination DC circuits
Calculating power in DC circuits
Applying fundamentals of magnetism and electromagnetism
Analyzing and modifying meter movements

Semiconductors

Analyzing the characteristics and functions of semiconductors
Analyzing the application and operation of semiconductor diodes
Analyzing the application and operation of zener diodes in regulator circuits
Analyzing the application and operation of tunnel, varactor and high frequency diodes
Analyzing the operation of bipolar transistors

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of

ELECTRONICS ASSEMBLER

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Electronics Assembler.

ELECTRONICS ASSEMBLER
(D.O.T. Code 726.684-018)

Basic Skills
Observing electrical safety precautions and first aid practices
Using hand tools
Using power tools
Soldering to terminals and PC boards
Selecting, preparing and installing wiring
Installing coaxial connectors
Performing a visual inspection of electronic equipment
Cleaning electronic equipment
Lubricating electronic equipment
Inspecting and replacing power cords and distribution cables
Keeping records on maintenance of equipment
Preparing parts lists

DC Electronics
Understanding fundamentals of electrical theory and electrical measurement
Using volt-ohm milliammeters (VOM)
Using electronic voltmeters (EVM)
Measuring current in DC circuits
Measuring voltage in DC circuits
Calculating and measuring resistance in DC circuits
Making calculations using Ohm's law
Calculating voltage, current and resistance in DC series circuits
Calculating total voltage, total current and total resistance
Calculating and measuring electrical quantities in combination DC circuits
Calculating power in DC circuits
Applying fundamentals of magnetism and electromagnetism
Analyzing and modifying meter movements

Semiconductors
Analyzing the characteristics and functions of semiconductors
Analyzing the application and operation of semiconductor diodes
Analyzing the application and operation of zener diodes in regulator circuits
Analyzing the application and operation of tunnel, varactor and high frequency diodes
Analyzing the operation of bipolar transistors

Servicing Components
Laying out, taping up and drawing basic printed circuit boards
Constructing printed circuit (PC) boards

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

ELECTRONICS INSPECTOR

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Electronics Inspector.

ELECTRONICS INSPECTOR
(D.O.T. Code 726.684-022)

Basic Skills
Observing electrical safety precautions and first aid practices
Using hand tools
Using power tools
Soldering to terminals and PC boards
Selecting, preparing and installing wiring
Installing coaxial connectors
Performing a visual inspection of electronic equipment
Cleaning electronic equipment
Lubricating electronic equipment
Inspecting and replacing power cords and distribution cables
Keeping records on maintenance of equipment
Preparing parts lists

DC Electronics
Understanding fundamentals of electrical theory and electrical measurement
Using volt-ohm milliammeters (VOM)
Using electronic voltmeters (EVM)
Measuring current in DC circuits
Measuring voltage in DC circuits
Calculating and measuring resistance in DC circuits
Making calculations using Ohm's law
Calculating voltage, current and resistance in DC series circuits
Calculating total voltage, total current and total resistance
Calculating and measuring electrical quantities in combination DC circuits
Calculating power in DC circuits
Applying fundamentals of magnetism and electromagnetism
Analyzing and modifying meter movements
Calculating values in DC network circuits
Calculating capacitance and time constants for RC circuits

AC Electronics
Calculating values for a right triangle
Using oscilloscopes
Analyzing AC sine waves
Measuring AC values for LF circuits
Determining reactance and impedance of capacitors in series and parallel circuits
Using capacitor testers
Calculating and measuring electrical values in AC capacitance circuits
Using impedance testers
Measuring inductance in series and parallel RL circuits
Computing turns, voltage, current and impedance ratios of transformers
Drawing phasor diagrams and calculating operating values for series AC circuits
Drawing phasor diagrams and calculating operating values for parallel AC circuits
Analyzing tuned AC circuits

Semiconductors
Analyzing the characteristics and functions of semiconductors
Analyzing the application and operation of semiconductor diodes
Analyzing the application and operation of zener diodes in regulator circuits
Analyzing the application and operation of tunnel, varactor and high frequency diodes
Analyzing the operation of bipolar transistors
Analyzing the operation of field effect transistors
Analyzing the operation of thyristors
Analyzing the operation of integrated circuits
Analyzing the operation of optoelectronic devices

Vacuum Tubes
Analyzing the operation of diode vacuum tubes
Analyzing the operation of triode vacuum tubes
Analyzing the operation of tetrode vacuum tubes
Analyzing the operation of pentode vacuum tubes
Inspecting and replacing vacuum tubes

Electronic Circuits I
Analyzing common emitter amplifier circuits
Analyzing the operation of DC and audio amplifiers
Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers
Testing amplifiers for amplification
Testing and repairing vacuum tube amplifiers
Testing and repairing transistor amplifiers
Analyzing power supply circuits
Testing and repairing power supplies
Calibrating power supply voltage

Electric Circuits II
Analyzing the operation of oscillators
Testing and repairing oscillators
Testing and repairing counter circuits
Analyzing pulse circuits
Testing and repairing nonsinusoidal amplifiers
Analyzing amplitude modulator (AM) circuits
Analyzing frequency modulator (FM) circuits
Analyzing the operation of superheterodyne receivers

Servicing Components
Laying out, taping up and drawing basic printed circuit boards
Constructing printed circuit (PC) boards

V-19

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

ELECTRONICS TESTER

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Electronics Tester.

ELECTRONICS TESTER
(D.O.T. Code 726.684-026)

Basic Skills

- Observing electrical safety precautions and first aid practices
- Using hand tools
- Using power tools
- Soldering to terminals and PC boards
- Selecting, preparing and installing wiring
- Installing coaxial connectors
- Performing a visual inspection of electronic equipment
- Cleaning electronic equipment
- Lubricating electronic equipment
- Inspecting and replacing power cords and distribution cables
- Keeping records on maintenance of equipment
- Preparing parts lists

DC Electronics

- Understanding fundamentals of electrical theory and electrical measurement
- Using volt-ohm milliammeters (VOM)
- Using electronic voltmeters (EVM)
- Measuring current in DC circuits
- Measuring voltage in DC circuits
- Calculating and measuring resistance in DC circuits
- Making calculations using Ohm's law
- Calculating voltage, current and resistance in DC series circuits
- Calculating total voltage, total current and total resistance
- Calculating and measuring electrical quantities in combination DC circuits
- Calculating power in DC circuits
- Applying fundamentals of magnetism and electromagnetism
- Analyzing and modifying meter movements
- Calculating values in DC network circuits
- Calculating capacitance and time constants for RC circuits

AC Electronics

- Calculating values for a right triangle
- Using oscilloscopes
- Analyzing AC sine waves
- Measuring AC values for LF circuits
- Determining reactance and impedance of capacitors in series and parallel circuits
- Using capacitor testers
- Calculating and measuring electrical values in AC capacitance circuits
- Using impedance testers
- Measuring inductance in series and parallel RL circuits
- Computing turns, voltage, current and impedance ratios of transformers
- Drawing phasor diagrams and calculating operating values for series AC circuits
- Drawing phasor diagrams and calculating operating values for parallel AC circuits
- Analyzing tuned AC circuits

Semiconductors

- Analyzing the characteristics and functions of semiconductors
- Analyzing the application and operation of semiconductor diodes
- Analyzing the application and operation of zener diodes in regulator circuits
- Analyzing the application and operation of tunnel, varactor and high frequency diodes
- Analyzing the operation of bipolar transistors
- Analyzing the operation of field effect transistors
- Analyzing the operation of thyristors
- Analyzing the operation of integrated circuits
- Analyzing the operation of optoelectronic devices

Vacuum Tubes

- Analyzing the operation of diode vacuum tubes
- Analyzing the operation of triode vacuum tubes
- Analyzing the operation of tetrode vacuum tubes
- Analyzing the operation of pentode vacuum tubes
- Inspecting and replacing vacuum tubes

Electronic Circuits I

- Analyzing common emitter amplifier circuits
- Analyzing the operation of DC and audio amplifiers
- Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers
- Testing amplifiers for amplification
- Testing and repairing vacuum tube amplifiers
- Testing and repairing transistor amplifiers
- Analyzing power supply circuits
- Testing and repairing power supplies
- Calibrating power supply voltage

Electric Circuits II

- Analyzing the operation of oscillators
- Testing and repairing oscillators
- Testing and repairing counter circuits
- Analyzing pulse circuits
- Testing and repairing nonsinusoidal amplifiers
- Analyzing amplitude modulator (AM) circuits
- Analyzing frequency modulator (FM) circuits
- Analyzing the operation of superheterodyne receivers

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

AUDIO-VIDEO REPAIRER

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Audio-Video Repairer.

AUDIO-VIDEO REPAIRER
(D.O.T. Code 729.281-010)

Basic Skills
Observing electrical safety precautions and first aid practices
Using hand tools
Using power tools
Soldering to terminals and PC boards
Selecting, preparing and installing wiring
Installing coaxial connectors
Performing a visual inspection of electronic equipment
Cleaning electronic equipment
Lubricating electronic equipment
Inspecting and replacing power cords and distribution cables
Keeping records on maintenance of equipment
Preparing parts lists

DC Electronics
Understanding fundamentals of electrical theory and electrical measurement
Using volt-ohm milliammeters (VOM)
Using electronic voltmeters (EVM)
Measuring current in DC circuits
Measuring voltage in DC circuits
Calculating and measuring resistance in DC circuits
Making calculations using Ohm's law
Calculating voltage, current and resistance in DC series circuits
Calculating total voltage, total current and total resistance
Calculating and measuring electrical quantities in combination DC circuits
Calculating power in DC circuits
Applying fundamentals of magnetism and electromagnetism
Analyzing and modifying meter movements
Calculating values in DC network circuits
Calculating capacitance and time constants for RC circuits

AC Electronics
Calculating values for a right triangle
Using oscilloscopes
Analyzing AC sine waves
Measuring AC values for LF circuits
Determining reactance and impedance of capacitors in series and parallel circuits
Using capacitor testers
Calculating and measuring electrical values in AC capacitance circuits
Using impedance testers
Measuring inductance in series and parallel RL circuits
Computing turns, voltage, current and impedance ratios of transformers
Drawing phasor diagrams and calculating operating values for series AC circuits
Drawing phasor diagrams and calculating operating values for parallel AC circuits
Analyzing tuned AC circuits

Semiconductors
Analyzing the characteristics and functions of semiconductors
Analyzing the application and operation of semiconductor diodes
Analyzing the application and operation of zener diodes in regulator circuits
Analyzing the application and operation of tunnel, varactor and high frequency diodes
Analyzing the operation of bipolar transistors
Analyzing the operation of field effect transistors
Analyzing the operation of thyristors
Analyzing the operation of integrated circuits
Analyzing the operation of optoelectronic devices

Vacuum Tubes
Analyzing the operation of diode vacuum tubes
Analyzing the operation of triode vacuum tubes
Analyzing the operation of tetrode vacuum tubes
Analyzing the operation of pentode vacuum tubes
Inspecting and replacing vacuum tubes

Electronic Circuits I
Analyzing common emitter amplifier circuits
Analyzing the operation of DC and audio amplifiers
Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers
Testing amplifiers for amplification
Testing and repairing vacuum tube amplifiers
Testing and repairing transistor amplifiers
Analyzing power supply circuits
Testing and repairing power supplies
Calibrating power supply voltage

Electric Circuits II
Analyzing the operation of oscillators
Testing and repairing oscillators
Testing and repairing counter circuits
Analyzing pulse circuits
Testing and repairing nonsinusoidal amplifiers
Analyzing amplitude modulator (AM) circuits
Analyzing frequency modulator (FM) circuits
Analyzing the operation of superheterodyne receivers

Servicing Components
Laying out, taping up and drawing basic printed circuit boards
Constructing printed circuit (PC) boards

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of

PUBLIC ADDRESS SERVICER

V-23

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Public Address Servicer.

PUBLIC ADDRESS SERVICER
(D.O.T. Code 823.261-010)

Basic Skills
Observing electrical safety precautions and first aid practices
Using hand tools
Using power tools
Soldering to terminals and PC boards
Selecting, preparing and installing wiring
Installing coaxial connectors
Performing a visual inspection of electronic equipment
Cleaning electronic equipment
Lubricating electronic equipment
Inspecting and replacing power cords and distribution cables
Keeping records on maintenance of equipment
Preparing parts lists

DC Electronics
Understanding fundamentals of electrical theory and electrical measurement
Using volt-ohm milliammeters (VOM)
Using electronic voltmeters (EVM)
Measuring current in DC circuits
Measuring voltage in DC circuits
Calculating and measuring resistance in DC circuits
Making calculations using Ohm's law
Calculating voltage, current and resistance in DC series circuits
Calculating total voltage, total current and total resistance
Calculating and measuring electrical quantities in combination DC circuits
Calculating power in DC circuits
Applying fundamentals of magnetism and electromagnetism
Analyzing and modifying meter movements
Calculating values in DC network circuits
Calculating capacitance and time constants for RC circuits

AC Electronics
Calculating values for a right triangle
Using oscilloscopes
Analyzing AC sine waves
Measuring AC values for LF circuits
Determining reactance and impedance of capacitors in series and parallel circuits
Using capacitor testers
Calculating and measuring electrical values in AC capacitance circuits
Using impedance testers
Measuring inductance in series and parallel RL circuits
Computing turns, voltage, current and impedance ratios of transformers
Drawing phasor diagrams and calculating operating values for series AC circuits
Drawing phasor diagrams and calculating operating values for parallel AC circuits
Analyzing tuned AC circuits

Semiconductors
Analyzing the characteristics and functions of semiconductors
Analyzing the application and operation of semiconductor diodes
Analyzing the application and operation of zener diodes in regulator circuits
Analyzing the application and operation of tunnel, varactor and high frequency diodes
Analyzing the operation of bipolar transistors
Analyzing the operation of field effect transistors
Analyzing the operation of thyristors
Analyzing the operation of integrated circuits
Analyzing the operation of optoelectronic devices

Vacuum Tubes
Analyzing the operation of diode vacuum tubes
Analyzing the operation of triode vacuum tubes
Analyzing the operation of tetrode vacuum tubes
Analyzing the operation of pentode vacuum tubes
Inspecting and replacing vacuum tubes

Electronic Circuits I
Analyzing common emitter amplifier circuits
Analyzing the operation of DC and audio amplifiers
Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers
Testing amplifiers for amplification
Testing and repairing vacuum tube amplifiers
Testing and repairing transistor amplifiers
Analyzing power supply circuits
Testing and repairing power supplies
Calibrating power supply voltage

Electric Circuits II
Analyzing the operation of oscillators
Testing and repairing oscillators
Testing and repairing counter circuits
Analyzing pulse circuits
Testing and repairing nonsinusoidal amplifiers
Analyzing amplitude modulator (AM) circuits
Analyzing frequency modulator (FM) circuits
Analyzing the operation of superheterodyne receivers

Servicing Components
Laying out, taping up and drawing basic printed circuit boards
Constructing printed circuit (PC) boards

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

RADIO REPAIRER
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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Radio Repairer.

RADIO REPAIRER
(D.O.T. Code 720.281-010)

Basic Skills
Observing electrical safety precautions and first aid practices
Using hand tools
Using power tools
Soldering to terminals and PC boards
Selecting, preparing and installing wiring
Installing coaxial connectors
Performing a visual inspection of electronic equipment
Cleaning electronic equipment
Lubricating electronic equipment
Inspecting and replacing power cords and distribution cables
Keeping records on maintenance of equipment
Preparing parts lists

DC Electronics
Understanding fundamentals of electrical theory and electrical measurement
Using volt-ohm milliammeters (VOM)
Using electronic voltmeters (EVM)
Measuring current in DC circuits
Measuring voltage in DC circuits
Calculating and measuring resistance in DC circuits
Making calculations using Ohm's law
Calculating voltage, current and resistance in DC series circuits
Calculating total voltage, total current and total resistance
Calculating and measuring electrical quantities in combination DC circuits
Calculating power in DC circuits
Applying fundamentals of magnetism and electromagnetism
Analyzing and modifying meter movements
Calculating values in DC network circuits
Calculating capacitance and time constants for RC circuits

AC Electronics
Calculating values for a right triangle
Using oscilloscopes
Analyzing AC sine waves
Measuring AC values for LF circuits
Determining reactance and impedance of capacitors in series and parallel circuits
Using capacitor testers
Calculating and measuring electrical values in AC capacitance circuits
Using impedance testers
Measuring inductance in series and parallel RL circuits
Computing turns, voltage, current and impedance ratios of transformers
Drawing phasor diagrams and calculating operating values for series AC circuits
Drawing phasor diagrams and calculating operating values for parallel AC circuits
Analyzing tuned AC circuits

Semiconductors
Analyzing the characteristics and functions of semiconductors
Analyzing the application and operation of semiconductor diodes
Analyzing the application and operation of zener diodes in regulator circuits
Analyzing the application and operation of tunnel, varactor and high frequency diodes
Analyzing the operation of bipolar transistors
Analyzing the operation of field effect transistors
Analyzing the operation of thyristors
Analyzing the operation of integrated circuits
Analyzing the operation of optoelectronic devices

Vacuum Tubes
Analyzing the operation of diode vacuum tubes
Analyzing the operation of triode vacuum tubes
Analyzing the operation of tetrode vacuum tubes
Analyzing the operation of pentode vacuum tubes
Inspecting and replacing vacuum tubes

Electronic Circuits I
Analyzing common emitter amplifier circuits
Analyzing the operation of DC and audio amplifiers
Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers
Testing amplifiers for amplification
Testing and repairing vacuum tube amplifiers
Testing and repairing transistor amplifiers
Analyzing power supply circuits
Testing and repairing power supplies
Calibrating power supply voltage

Electric Circuits II
Analyzing the operation of oscillators
Testing and repairing oscillators
Testing and repairing counter circuits
Analyzing pulse circuits
Testing and repairing nonsinusoidal amplifiers
Analyzing amplitude modulator (AM) circuits
Analyzing frequency modulator (FM) circuits
Analyzing the operation of superheterodyne receivers

Servicing Components
Laying out, taping up and drawing basic printed circuit boards
Constructing printed circuit (PC) boards

V-27

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of

RADIO MECHANIC

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Radio Mechanic.

RADIO MECHANIC
(D.O.T. Code 823.261-018)

Basic Skills
Observing electrical safety precautions and first aid practices
Using hand tools
Using power tools
Soldering to terminals and PC boards
Selecting, preparing and installing wiring
Installing coaxial connectors
Performing a visual inspection of electronic equipment
Cleaning electronic equipment
Lubricating electronic equipment
Inspecting and replacing power cords and distribution cables
Keeping records on maintenance of equipment
Preparing parts lists

DC Electronics
Understanding fundamentals of electrical theory and electrical measurement
Using volt-ohm milliammeters (VOM)
Using electronic voltmeters (EVM)
Measuring current in DC circuits
Measuring voltage in DC circuits
Calculating and measuring resistance in DC circuits
Making calculations using Ohm's law
Calculating voltage, current and resistance in DC series circuits
Calculating total voltage, total current and total resistance
Calculating and measuring electrical quantities in combination DC circuits
Calculating power in DC circuits
Applying fundamentals of magnetism and electromagnetism
Analyzing and modifying meter movements
Calculating values in DC network circuits
Calculating capacitance and time constants for RC circuits

AC Electronics
Calculating values for a right triangle
Using oscilloscopes
Analyzing AC sine waves
Measuring AC values for LF circuits
Determining reactance and impedance of capacitors in series and parallel circuits
Using capacitor testers
Calculating and measuring electrical values in AC capacitance circuits
Using impedance testers
Measuring inductance in series and parallel RL circuits
Computing turns, voltage, current and impedance ratios of transformers
Drawing phasor diagrams and calculating operating values for series AC circuits
Drawing phasor diagrams and calculating operating values for parallel AC circuits
Analyzing tuned AC circuits

Semiconductors
Analyzing the characteristics and functions of semiconductors
Analyzing the application and operation of semiconductor diodes
Analyzing the application and operation of zener diodes in regulator circuits
Analyzing the application and operation of tunnel, varactor and high frequency diodes
Analyzing the operation of bipolar transistors
Analyzing the operation of field effect transistors
Analyzing the operation of thyristors
Analyzing the operation of integrated circuits
Analyzing the operation of optoelectronic devices

Vacuum Tubes
Analyzing the operation of diode vacuum tubes
Analyzing the operation of triode vacuum tubes
Analyzing the operation of tetrode vacuum tubes
Analyzing the operation of pentode vacuum tubes
Inspecting and replacing vacuum tubes

Electronic Circuits I
Analyzing common emitter amplifier circuits
Analyzing the operation of DC and audio amplifiers
Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers
Testing amplifiers for amplification
Testing and repairing vacuum tube amplifiers
Testing and repairing transistor amplifiers
Analyzing power supply circuits
Testing and repairing power supplies
Calibrating power supply voltage

Electric Circuits II
Analyzing the operation of oscillators
Testing and repairing oscillators
Testing and repairing counter circuits
Analyzing pulse circuits
Testing and repairing nonsinusoidal amplifiers
Analyzing amplitude modulator (AM) circuits
Analyzing frequency modulator (FM) circuits
Analyzing the operation of superheterodyne receivers

Servicing Components
Laying out, taping up and drawing basic printed circuit boards
Constructing printed circuit (PC) boards

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

TELEVISION AND RADIO REPAIRER
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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Television and Radio Repairer.

TELEVISION AND RADIO REPAIRER
(D.O.T. Code 720.281-018)

Basic Skills
- Observing electrical safety precautions and first aid practices
- Using hand tools
- Using power tools
- Soldering to terminals and PC boards
- Selecting, preparing and installing wiring
- Installing coaxial connectors
- Performing a visual inspection of electronic equipment
- Cleaning electronic equipment
- Lubricating electronic equipment
- Inspecting and replacing power cords and distribution cables
- Keeping records on maintenance of equipment
- Preparing parts lists

DC Electronics
- Understanding fundamentals of electrical theory and electrical measurement
- Using volt-ohm milliammeters (VOM)
- Using electronic voltmeters (EVM)
- Measuring current in DC circuits
- Measuring voltage in DC circuits
- Calculating and measuring resistance in DC circuits
- Making calculations using Ohm's law
- Calculating voltage, current and resistance in DC series circuits
- Calculating total voltage, total current and total resistance
- Calculating and measuring electrical quantities in combination DC circuits
- Calculating power in DC circuits
- Applying fundamentals of magnetism and electromagnetism
- Analyzing and modifying meter movements
- Calculating values in DC network circuits
- Calculating capacitance and time constants for RC circuits

AC Electronics
- Calculating values for a right triangle
- Using oscilloscopes
- Analyzing AC sine waves
- Measuring AC values for LF circuits
- Determining reactance and impedance of capacitors in series and parallel circuits
- Using capacitor testers
- Calculating and measuring electrical values in AC capacitance circuits
- Using impedance testers
- Measuring inductance in series and parallel RL circuits
- Computing turns, voltage, current and impedance ratios of transformers
- Drawing phasor diagrams and calculating operating values for series AC circuits
- Drawing phasor diagrams and calculating operating values for parallel AC circuits
- Analyzing tuned AC circuits

Semiconductors
- Analyzing the characteristics and functions of semiconductors
- Analyzing the application and operation of semiconductor diodes
- Analyzing the application and operation of zener diodes in regulator circuits
- Analyzing the application and operation of tunnel, varactor and high frequency diodes
- Analyzing the operation of bipolar transistors
- Analyzing the operation of field effect transistors
- Analyzing the operation of thyristors
- Analyzing the operation of integrated circuits
- Analyzing the operation of optoelectronic devices

Vacuum Tubes
- Analyzing the operation of diode vacuum tubes
- Analyzing the operation of triode vacuum tubes
- Analyzing the operation of tetrode vacuum tubes
- Analyzing the operation of pentode vacuum tubes
- Inspecting and replacing vacuum tubes

Electronic Circuits I
- Analyzing common emitter amplifier circuits
- Analyzing the operation of DC and audio amplifiers
- Analyzing the operation of differential amplifiers, operational amplifiers, inverting and noninverting amplifiers
- Testing amplifiers for amplification
- Testing and repairing vacuum tube amplifiers
- Testing and repairing transistor amplifiers
- Analyzing power supply circuits
- Testing and repairing power supplies
- Calibrating power supply voltage

Electric Circuits II
- Analyzing the operation of oscillators
- Testing and repairing oscillators
- Testing and repairing counter circuits
- Analyzing pulse circuits
- Testing and repairing nonsinusoidal amplifiers
- Analyzing amplitude modulator (AM) circuits
- Analyzing frequency modulator (FM) circuits
- Analyzing the operation of superheterodyne receivers

Servicing Components
- Servicing tape recorders
- Servicing record changers
- Inspecting and repairing loudspeakers
- Inspecting and repairing microphones
- Laying out, taping up and drawing basic printed circuit boards
- Constructing printed circuit (PC) boards

Television I
- Analyzing the stages of a black and white TV receiver
- Analyzing low voltage power supplies
- Troubleshooting switch-mode secondary voltage supplies
- Troubleshooting synchronizing and deflection circuits

Television II
- Troubleshooting horizontal output circuits
- Troubleshooting sweep-generator circuits
- Troubleshooting high voltage supplies
- Aligning the CRT and associated circuits
- Troubleshooting vertical deflection circuits
- Adjusting the purity, focus and gray scale to produce a normal raster
- Analyzing the operation of video amplifiers
- Troubleshooting defective video amplifiers
- Analyzing video IF amplifiers
- Aligning RF and IF amplifiers
- Analyzing the operation of sound IF and AM circuits
- Aligning sound IF and AM circuits
- Analyzing VHF and UHF tuner circuits
- Analyzing automatic fine tuning (AFT) and remote control circuits
- Analyzing automatic gain control (AGC) and noise canceling circuits

TV Color Section
- Analyzing color television signal reception and decoding
- Testing picture tubes and associated circuits
- Analyzing band-pass amplifiers, color killer circuits and automatic color control circuits
- Analyzing color sync circuits
- Analyzing color demodulator and output amplifier circuits
- Troubleshooting defective color tuning circuits
- Analyzing and adjusting color convergence circuits

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

____

has successfully mastered the competencies required to perform the job of

INSTALLER

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Installer.

INSTALLER
(D.O.T. Code 823.361-010)

Basic Skills

- Observing electrical safety precautions and first aid practices
- Using hand tools
- Using power tools
- Soldering to terminals and PC boards
- Selecting, preparing and installing wiring
- Installing coaxial connectors
- Performing a visual inspection of electronic equipment
- Cleaning electronic equipment
- Inspecting and replacing power cords and distribution cables
- Keeping records on maintenance of equipment
- Preparing parts lists

DC Electronics

- Understanding fundamentals of electrical theory and electrical measurement
- Using volt-ohm milliammeters (VOM)
- Using electronic voltmeters (EVM)
- Measuring current in DC circuits
- Measuring voltage in DC circuits
- Calculating and measuring resistance in DC circuits

GROUP PROGRESS CHART

NAME	UNITS/TASKS																				

SECTION VI

FACILITIES

SECTION VI

Section VI Content List

Group Instruction Facilities
Individualized Instruction Facilities

The facility layouts on the following pages are presented to aid in arranging the classroom and laboratory for efficient instruction. The school administration and program instructor must determine an arrangement that best fits the needs of the students by determining the most efficient use of resources available to them not only in the laboratory, but also in the Learning Resource Center settings.

FACILITY LAYOUTS

The layouts on the following pages illustrate how facilities for group and individualized instructional programs may be planned and set up.

Each instructional approach has two important physical areas. These are (1) the laboratory (work) area and classroom for group instruction and (2) the laboratory (work) area and learning resource center (LRC) for individualized instruction.

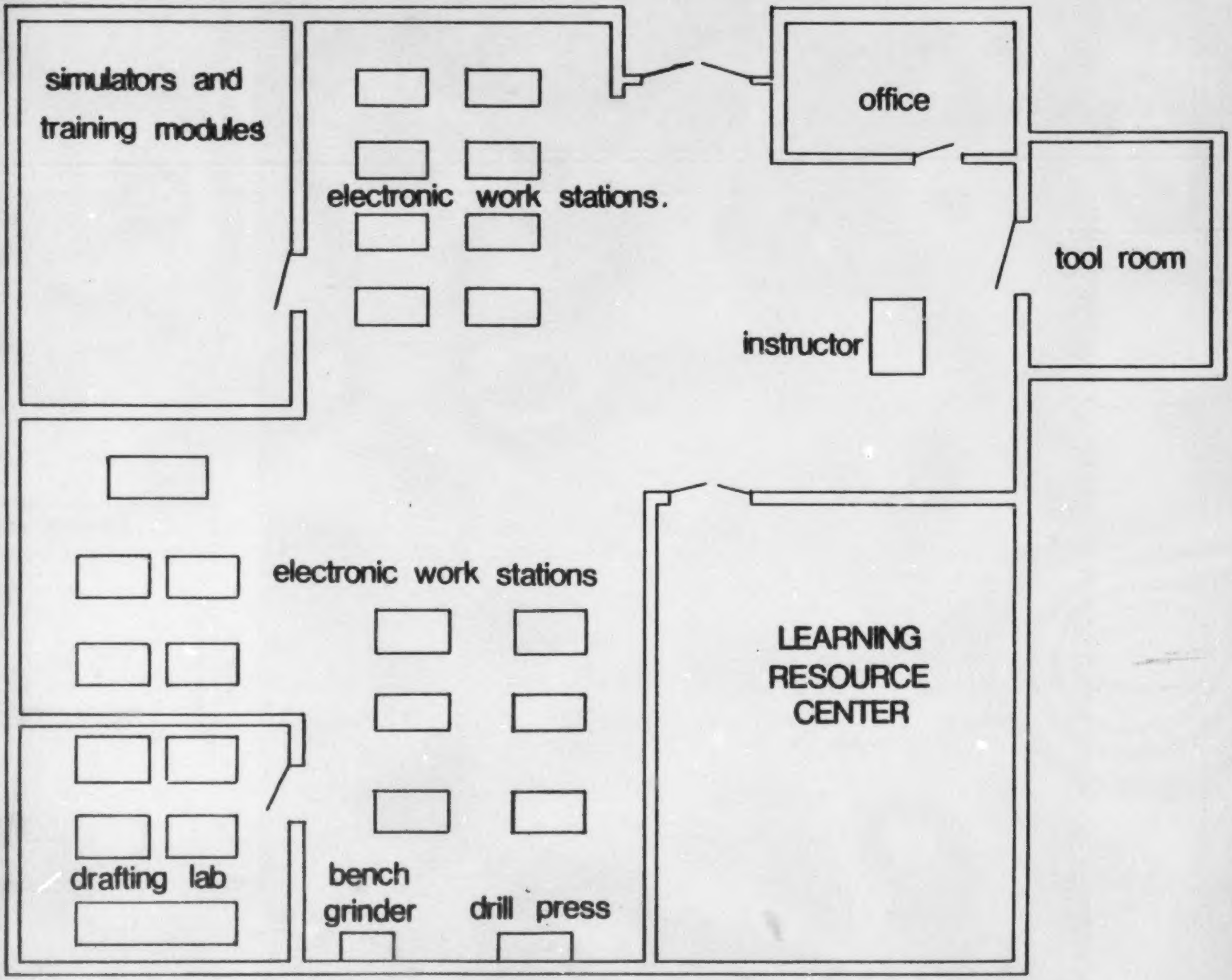
The instructional setting for group instruction is based on that of a traditional classroom. This approach is easily set up and includes little or no modifications. The primary modes of learning are instructor lectures, occasional use of audiovisual aids and student participation. Ideally, all students progress at the same pace.

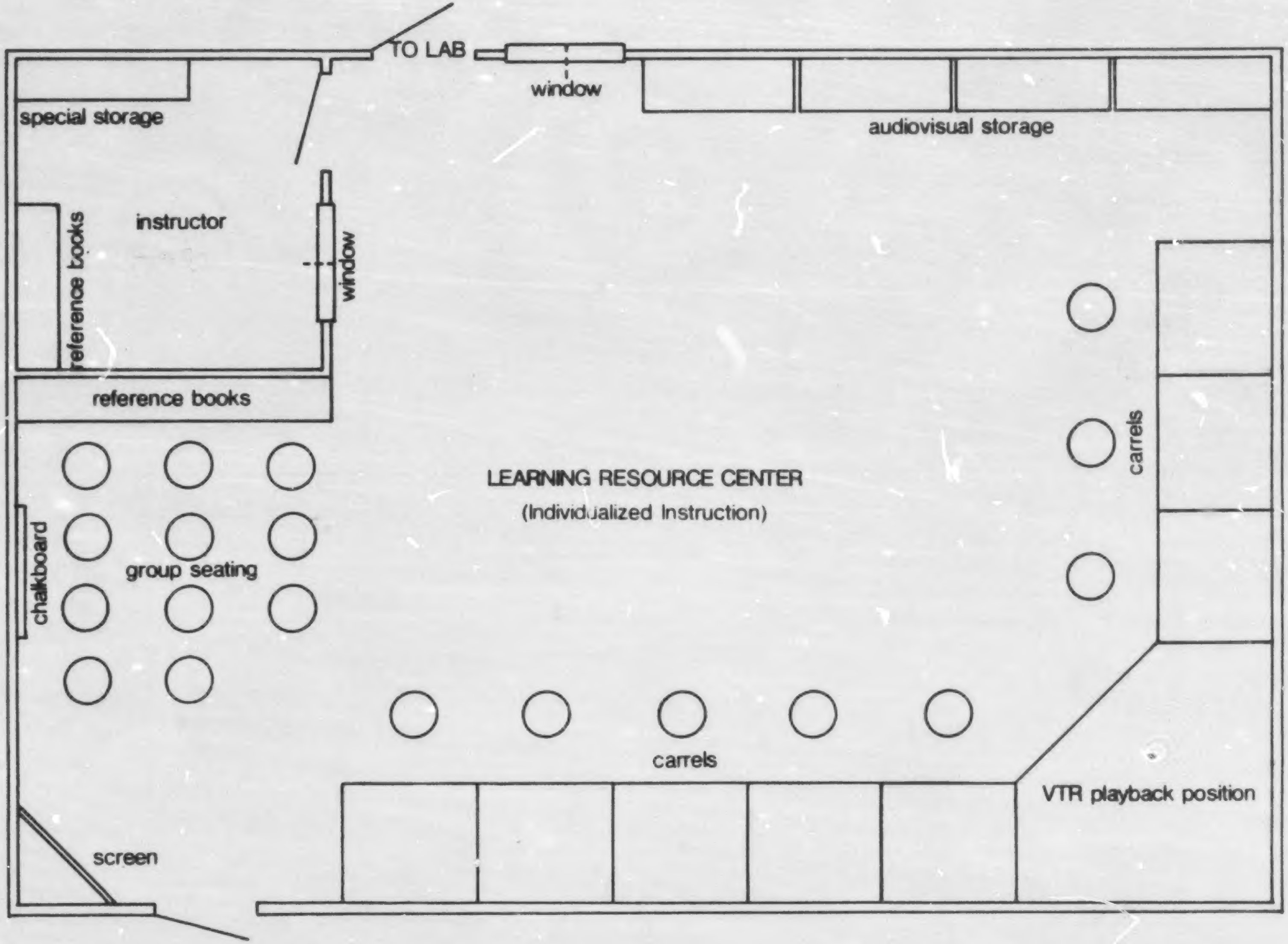
The instructional setting for individual instruction is designed to facilitate a student self-paced progression of learning. The LRC requires careful planning in utilizing available space. When planning to install an individual instruction program in an area not originally designed for this approach, the instructional setting may need modifications. Desks may be replaced with study carrels to allow students to simultaneously participate in a variety of learning activities. A group session area for small group gatherings should also be included. Because the instructor and students rarely meet together as a group, a bulletin board becomes a vital communication device in an LRC. It can be used to post announcements and such instructional information as group progress charts, assignments, positions available in the industry and safety rules.

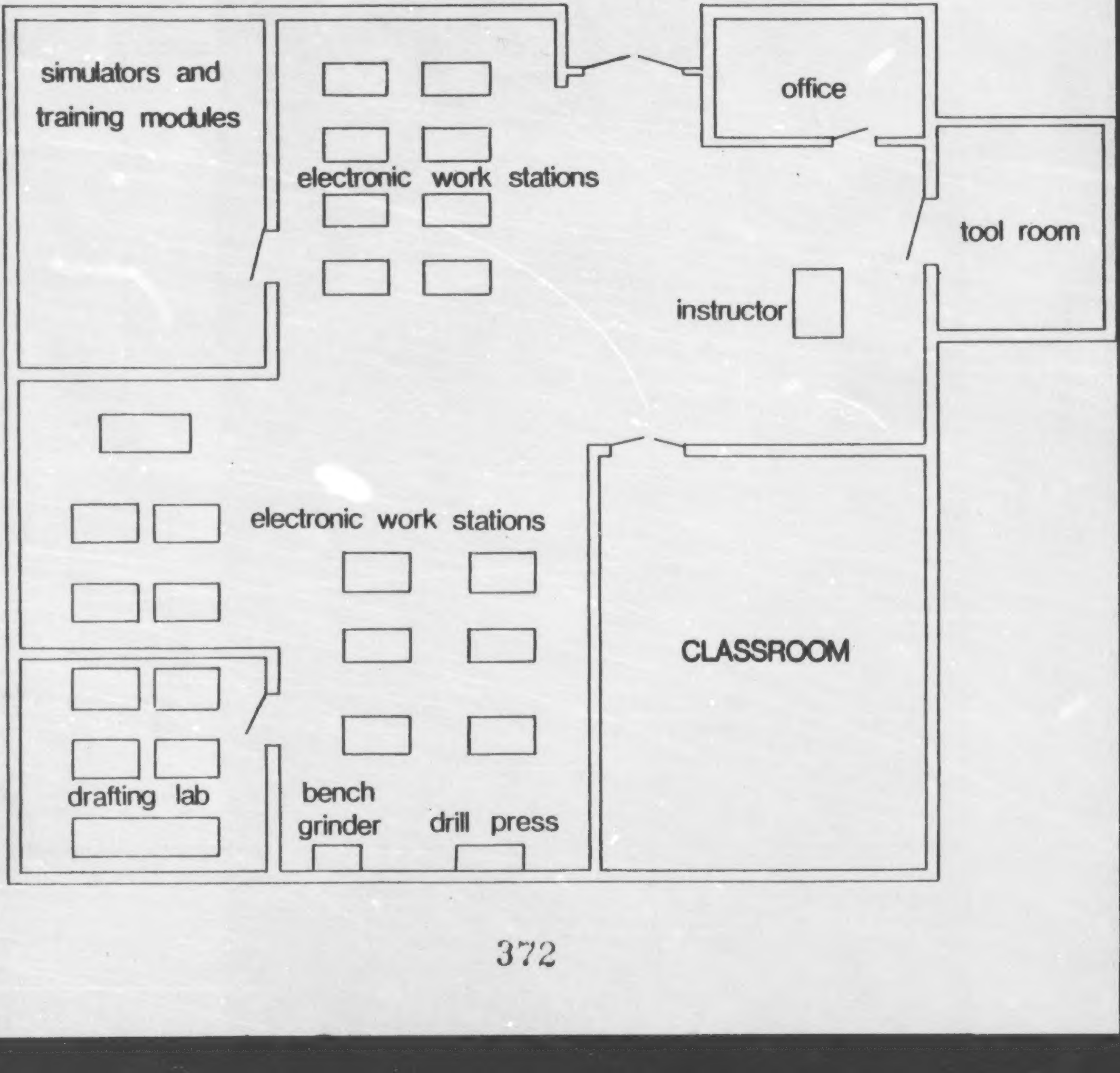
A variety of references, resources and media equipment should be made available to the student. Therefore, an adequate amount of storage area should be included in planning the LRC. Every specific school and department has unique physical layout characteristics and problems. Through innovation, these features may be transformed into LRC advantages rather than disadvantages.

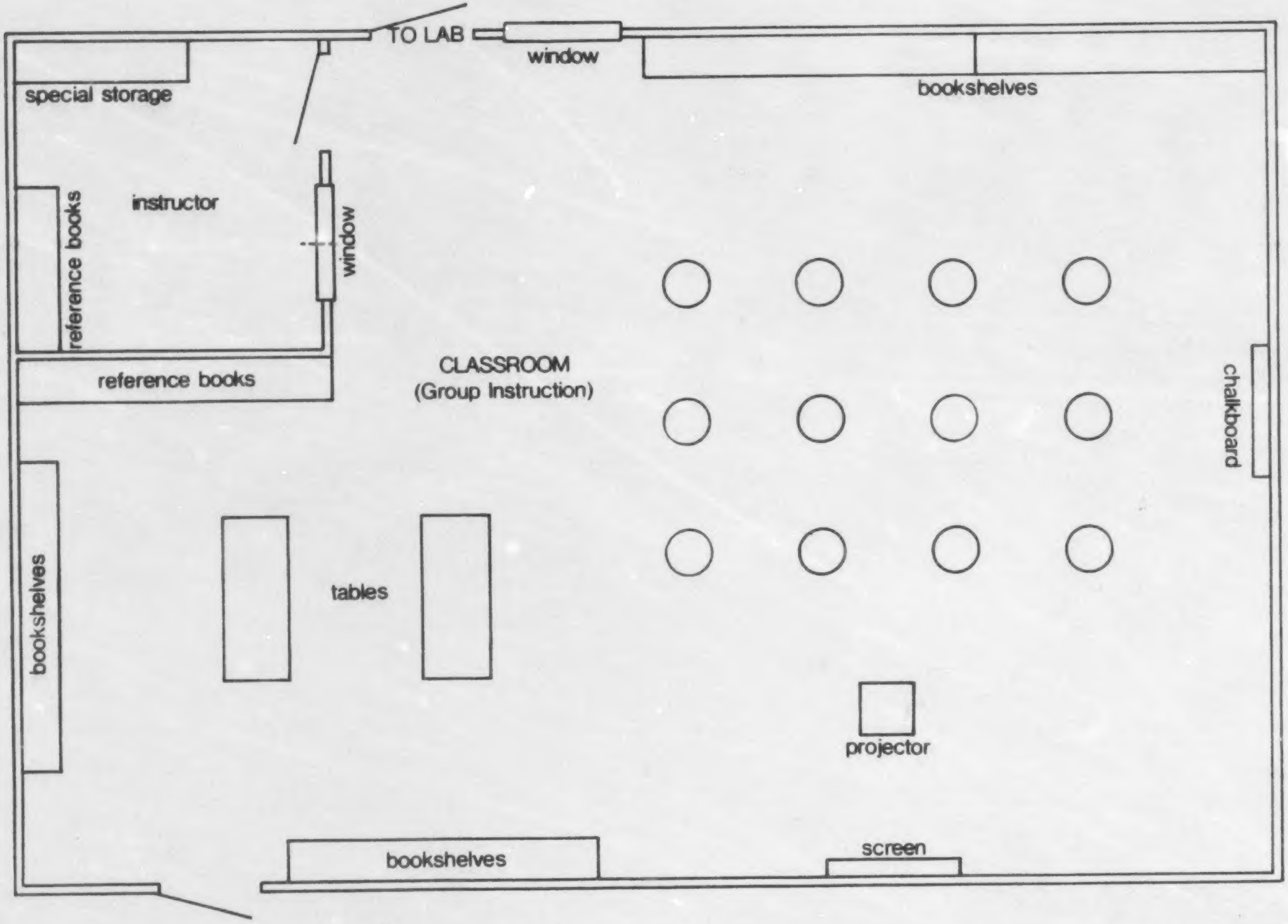
The manner in which the laboratory (work) area is planned and set up need not be affected by the type of instructional approach used by an instructor; it could/will be the same. Some major concerns in the laboratory are: 1) the instructor must always have a clear line of sight to each and every workstation, 2) tools must be accessible to students, but under the control of the instructor and 3) all supplies and materials required for the day's activities must be on hand and ready to use.

The laboratory (work) area facility suggested here has been intentionally left spacious to accommodate the instructor in demonstrations and student practice of tasks such as pacing, target use, using the transit and level rod, setting points on line, etc.


simulators and training modules
electronic work stations.
office
tool room
instructor
electronic work stations
LEARNING RESOURCE CENTER
drafting lab
bench grinder
drill press


TO LAB
window
special storage
audiovisual storage
instructor
reference books
window
reference books
carrels
LEARNING RESOURCE CENTER
(Individualized Instruction)
chalkboard
group seating
carrels
VTR playback position
screen


simulators and training modules
electronic work stations
office
tool room
instructor
electronic work stations
CLASSROOM
drafting lab
bench grinder
drill press


TO LAB
window
bookshelves
special storage
instructor
reference books
window
CLASSROOM
(Group Instruction)
reference books
chalkboard
bookshelves
tables
projector
bookshelves
screen

APPENDIX A

Resources

RESOURCES

This appendix contains the instructional resource matrix, unit guide reference and additional instructional materials.

The instructional resource matrix lists the audiovisuals, textbooks and student manuals for each task referenced on the unit guide sheets. The audiovisual format is identified by the symbols such as: filmstrip (FS), slide/script (SS), slide/tape (ST), 16mm movie film (MF), transparency (TR), video tape (VT) and filmloop (FL). The producer, title and number of the A/V is also given.

The unit guide bibliography lists textbooks, audiovisuals, student manuals and evaluation materials cited in the unit guides section.

The additional instructional materials is a compilation of textbooks and audiovisuals not included in the unit guides but beneficial to educators.

Resources addresses for all references concludes this appendix.

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
BS-01 Observing electrical safety precautions and first aid practices	Career Aids, Inc.: "Electrical Safety in the Shop," (FS); "Electricity/Electronics," (FS); Georgia: Electronics Technology, Phase A, "Safety and Shop Practices," (ST) 3-A	Grob: Basic Electronics; Georgia: Electronics Technology, Phase A, Unit 3-A; MAVVC: Basic Electronics 1; Heathkit: DC Electronics	Heathkit: DC Electronics, Student Workbook; Georgia: Electronics Technology, Phase A, Unit 3-A
BS-02 Using hand tools	Hobar: "Hammer, Nails and Nailing Techniques," (ST); "Screws and Driving Tools," (ST); Career Aids, Inc.: "Using Hand Tools, Part 1," (TR); "Using Hand Tools, Part 2," (TR)	Dover Publications, Inc.: Tools and Their Uses; MAVCC: Basic Electronics 1	
BS-03 Using power tools	Hobar: "Safety: Machine and Power Tools," (TR)	Dover Publications, Inc.: Tools and Their Uses	
BS-04 Soldering to terminals and PC boards	Georgia: Electronics Technology, Phase A, "Soldering Principles," (ST) 5-A	Duarte and Duarte: Electronics Assembly and Fabrication Methods; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Unit 5-A
BS-05 Selecting, preparing and installing wiring	Georgia: Electronics Technology, Phase A, "Wire, Tools and Wirestripping," (ST) 4-A	Grob: Basic Electronics; Duarte and Duarte: Electronics Assembly and Fabrication Methods; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Units 4-A and 6-A
BS-06 Installing coaxial connectors		ARRL: Radio Amateur's Handbook	

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
BS-07 Performing a visual inspection of electronic equipment		Equipment service manuals	
BS-08 Cleaning electronic equipment		Equipment service manuals; Solvent specifications	
BS-09 Lubricating electronic equipment		Equipment service manuals; Lubricant specifications	
BS-10 Inspecting and replacing power cords and distribution cables		Duarte: Electronics Assembly and Fabrication Methods; Equipment service manual; Test equipment operation manual; Parts catalogs	
BS-11 Keeping records on maintenance of equipment			
BS-12 Preparing parts lists			

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
DC-01 Understanding fundamentals of electrical theory and electrical measurement		Grob: Basic Electronics; MAVCC: Basic Electronics 1; Singer: Basic Mathematics for Electricity and Electronics; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Unit 9-A
DC-02 Using volt-ohm milliammeters (VOM)	Georgia: Electronics Technology, Phase A, "Use and Care of the VOM and VTVM," 14-A (ST)	Grob: Basic Electronics; Gilli: Electrical Principles for Electronics; Heathkit: DC Electronics; MAVCC: Basic Electronics 1	Heathkit: DC Electronics, Student Workbook; Georgia: Electronics Technology, Phase A, Unit 14
DC-03 Using electronic voltmeters (EVM)	Georgia: Electronics Technology, Phase A, "Use and Care of the VOM and VTVM," (ST)	Grob: Basic Electronics; Gilli: Electrical Principles for Electronics; Georgia: Electronics Technology, Phase A	
DC-04 Measuring current in DC circuits	Georgia: Electronics Technology, Phase A, "Measuring Electrical Current," 10-A (ST)	Grob: Basic Electronics; MAVCC: Basic Electronics 1; Singer: Basic Mathematics for Electricity and Electronics; Heathkit: DC Electronics; Georgia: Electronics Technology, Phase A	Heathkit: DC Electronics, Student Workbook; Georgia: Electronics Technology, Phase A, Units 10-A and 13-A
DC-05 Measuring voltage in DC circuits	Georgia: Electronics Technology, Phase A, "Measuring Electrical Voltage," 11-A (ST)	Grob: Basic Electronics; MAVCC: Basic Electronics 1; Heathkit: DC Electronics; Georgia: Electronics Technology, Phase A	Heathkit: DC Electronics, Student Workbook; Georgia: Electronics Technology, Phase A; Meade: Programmed Projects

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
DC-06 Calculating and measuring resistance in DC circuits	Georgia: Electronics Technology, Phase A, "Resistor Color Code," Part #1, 8-A (ST)	MAVCC: Basic Electronics 1; Heathkit: DC Electronics; Georgia: Electronics Technology, Phase A	Heathkit: DC Electronics; Student Workbook; Georgia: Electronics Technology, Phase A, Units 8-A and 12-A
DC-07 Making calculations using Ohm's law		MAVCC: Basic Electronics 1; Singer: Basic Mathematics for Electricity and Electronics; Georgia: Electronics Technology, Phase A; Grob: Basic Electronics	Meade: Programmed Projects; Georgia: Electronics Technology, Phase A, Unit 15-A
DC-08 Calculating voltage, current and resistance in DC series circuits		MAVCC: Basic Electronics 1; Singer: Basic Mathematics for Electricity and Electronics; Grob: Basic Electronics; Georgia: Electronics Technology, Phase A	Meade: Programmed Projects; Georgia: Electronics Technology, Phase A, Unit 18-A
DC-09 Calculating total voltage, total current and total resistance		MAVCC: Basic Electronics 1; Singer: Basic Mathematics for Electricity and Electronics; Georgia: Electronics Technology, Phase A; Grob: Basic Electronics	Georgia: Electronics Technology, Phase A, Unit 19-A; Meade: Programmed Projects
DC-10 Calculating and measuring electrical quantities in combination DC circuits		Grob: Basic Electronics; MAVCC: Basic Electronics 1; Singer: Basic Mathematics for Electricity and Electronics; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Unit 20-A; Meade: Programmed Projects

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
DC-11 Calculating power in DC circuits		MAVCC: Basic Electronics 1; Singer: Basic Mathematics for Electricity and Electronics; Heathkit: DC Electronics; Georgia: Electronics Technology, Phase A; Grob: Basic Electronics	Georgia: Electronics Technology, Phase A, Unit 16-A; Meade: Programmed Projects
DC-12 Applying fundamentals of magnetism and electromagnetism	Georgia: Electronics Technology, Phase A, "Basic Introduction to Magnetism," 25-A (ST)	MAVCC: Basic Electronics 1; Heathkit: DC Electronics; Georgia: Electronics Technology, Phase A; Grob: Basic Electronics	Georgia: Electronics Technology, Phase A, Unit 25-A;
DC-13 Analyzing and modifying meter movements	Georgia: Electronics Technology, Phase A, "Proper Use and Care of Meters," 14-A (ST); "The Ayrton or Universal Meter Shunt," 22-A (ST)	Georgia: Electronics Technology, Phase A; Grob: Basic Electronics; Heathkit: DC Electronics; MAVCC: Basic Electronics 1	Georgia: Electronics Technology, Phase A, Units 14-A and 22-A; Heathkit: DC Electronics; Meade: Programmed Projects
DC-14 Calculating values in DC network circuits		Grob: Basic Electronics; Georgia, Electronics Technology, Phase A; Heathkit: DC Electronics; MAVCC: Basic Electronics 1	Meade: Programmed Projects; Georgia: Electronics Technology, Phase A, Unit 21-A; Heathkit: DC Electronics
DC-15 Calculating capacitance and time constants for RC circuits		Grob: Basic Electronics; Georgia: Electronics Technology, Phase A; Heathkit: DC Electronics; MAVCC: Basic Electronics 1	Meade: Programmed Projects; Georgia: Electronics Technology, Phase A, Unit 33-A; Heathkit: DC Electronics

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
AC-01 Calculating values for a right triangle		Singer: Basic Mathematics for Electricity and Electronics	
AC-02 Using oscilloscopes	Georgia: Electronics Technology, Phase A, "Function and Use of the Oscilloscope," (ST) 28-A: Bergwall: "Basic Electricity and Electronics Explained-AC," (FS) 802-3, 802-4, 802-5	Zbar: Basic Electricity; Gilmore: Instruments and Measurements; Heathkit: Electronic Circuits; Georgia: Electronics Technology, Phase A, Unit 28-A; MAVCC: Basic Electronics 1	
AC-03 Analyzing AC sine waves	Georgia: Electronics Technology, Phase A, "Introduction to Basic Oscilloscope Controls," (ST) 28-A	Heathkit: AC Electronics; MAVCC: Basic Electronics 1; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Unit 28-A
AC-04 Measuring AC values for LF circuits	Georgia: Electronics Technology, Phase A, "Important AC Units and Terms," (ST) 26-A	Heathkit: AC Electronics; Training and Retraining, Inc.: Basic Electricity/Electronics; Grob: Basic Electronics; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Unit 26-A; Heathkit: AC Electronics

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
AC-05 Determining reactance and impedance of capacitors in series and parallel circuits		Singer: Basic Mathematics for Electricity and Electronics; Georgia: Electronics Technology, Phase A; Grob: Basic Electronics; Training and Retraining, Inc.: Basic Electricity/Electronics; Duarte: Electronics Assembly and Fabrication Methods; Heathkit: AC Electronics	Meade: Programmed Projects; Georgia: Electronics Technology, Phase A, Unit 31-A; Heathkit: AC Electronics
AC-06 Using capacitor testers		Heathkit: DC Electronics; Georgia: Electronics Technology, Phase A; MAVCC: Basic Electronics 1	Heathkit: DC Electronics, Student Workbook; Georgia: Electronics Technology, Phase A, Units 31-A and 32-A
AC-07 Calculating and measuring electrical values in AC capacitance circuits		Heathkit: AC Electronics; MAVCC: Basic Electronics 1; Georgia: Basic Electronics Technology, Phase A	Meade: Programmed Projects; Georgia: Electronics Technology, Phase A, Unit 32-A; Heathkit: AC Electronics
AC-08 Using impedance testers		Heathkit: AC Electronics; MAVCC: Basic Electronics 1	Heathkit: AC Electronics, Student Workbook
AC-09 Measuring inductance in series and parallel RL circuits		Heathkit: AC Electronics; MAVCC: Basic Electronics 1; Georgia: Electronics Technology, Phase A; Grob: Basic Electronics	Georgia: Electronics Technology, Phase A, Units 27-A, 29-A and 30-A; Meade: Programmed Projects; Heathkit: AC Electronics

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
AC-10 Computing turns, voltage, current and impedance ratios of transformers	Georgia: Electronics Technology, Phase A, "Transformer Impedance Ratio," (ST) 37-A	Heathkit: AC Electronics; Grob: Basic Electronics; Georgia: Electronics Technology, Phase A	Heathkit: AC Electronics; Georgia: Electronics Technology, Phase A, Unit 37-A
AC-11 Drawing phasor diagrams and calculating operating values for series AC circuits	Georgia: Electronics Technology, Phase A, "Measuring Frequency and Phase With a Scope," (ST) 38-A	Singer: Basic Mathematics for Electricity and Electronics; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Unit 38-A
AC-12 Drawing phasor diagrams and calculating operating values for parallel AC circuits	Georgia: Electronics Technology, Phase A, "Measuring Frequency and Phase With a Scope," (ST) 38-A	Singer: Basic Mathematics for Electricity and Electronics; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Units 34-A and 38-A
AC-13 Analyzing tuned AC circuits		Heathkit: AC Electronics; Grob: Basic Electronics; Georgia: Electronics Technology, Phase A	Georgia: Electronics Technology, Phase A, Units 35-A and 36-A; Heathkit: AC Electronics

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
SC-01	Analyzing the characteristics and functions of semiconductors		Heathkit: Semiconductor Devices; Georgia: Electronics; Grob: Basic Electronics	Georgia: Electronics, Phase B, Units 1-B and 2-B; Heathkit: Semiconductor Devices; Oleksy: Solid-State Electronics
SC-02	Analyzing the application and operation of semiconductor diodes		Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B; Zbar: Basic Electronics	Georgia: Electronics, Phase B, Unit 3-B; Heathkit: Semiconductor Devices; Oleksy: Solid-State Electronics; Zbar: Basic Electronics
SC-03	Analyzing the application and operation of zener diodes in regulator circuits		Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B; Zbar: Basic Electronics	Georgia: Electronics, Phase B; Heathkit: Semiconductor Devices; Zbar: Basic Electronics
SC-04	Analyzing the application and operation of tunnel, varator and high frequency diodes		Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B	Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B; Oleksy: Solid-State Electronics; Zbar: Basic Electronics
SC-05	Analyzing the operation of bipolar transistors		Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B	Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B; Zbar: Basic Electronics; Oleksy: Solid-State Electronics
SC-06	Analyzing the operation of field effect transistors		Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B	Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B, Unit 12-B; Oleksy: Solid-State Electronics

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
SC-07 Analyzing the operation of thyristors		Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B	Heathkit: Semiconductor Devices; Georgia: Electronics, Phase B, Unit 12-B; Oleksy: Solid-State Electronics
SC-08 Analyzing the operation of integrated circuits		Heathkit: Semiconductor Devices; Georgia: Electronics Technology, Integrated Circuits	Heathkit: Semiconductor Devices; Georgia: Electronics Technology, Integrated Circuits, Units IC-1 through IC-11
SC-09 Analyzing the operation of optoelectronic devices		Heathkit: Semiconductor Devices; Georgia: Electronics Technology, Integrated Circuits	Heathkit: Semiconductor Devices; Georgia: Electronics Technology, Integrated Circuits

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
VT-01 Analyzing the operation of diode vacuum tubes		Grob: Basic Electronics; Manufacturer's tube manual; Georgia: Electronics, Phase B; Training and Retraining, Inc.: Basic Electricity/Electronics	Georgia: Electronics, Phase B, Unit 13-B
VT-02 Analyzing the operation of triode vacuum tubes		Grob: Basic Electronics; Manufacturer's tube manual; Georgia: Electronics, Phase B; Training and Retraining, Inc.: Basic Electricity/Electronics	Georgia: Electronics, Phase B, Unit 13-B and 14-B
VT-03 Analyzing the operation of tetrode vacuum tubes		Grob: Basic Electronics; Manufacturer's tube manual; Training and Retraining Inc.: Basic Electricity/Electronics	
VT-04 Analyzing the operation of pentode vacuum tubes		Grob: Basic Electronics; Manufacturer's tube manual; Training and Retraining, Inc.: Basic Electricity/Electronics	
VT-05 Inspecting and replacing vacuum tubes		Equipment service manual; Tube manuals; Applicable legal restrictions; Parts catalogs; Tube tester operation manual	

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
EC-01 Analyzing common-emitter amplifier circuits		Heathkit: Electronic Circuits; Grob: Basic Electronics; Shrader: Electronic Communications	Heathkit: Electronic Circuits, Student Workbook; Georgia: Electronics, Phase B
EC-02 Analyzing the operation of DC and audio amplifiers		Heathkit: Electronic Circuits; Grob: Basic Electronics; Shrader: Electronic Communications	Heathkit: Electronic Circuits, Student Workbook; Georgia: Electronics, Phase B
EC-03 Analyzing the operation of differential amplifiers, operational amplifiers, inverting and non-inverting amplifiers		Heathkit: Electronic Circuits; Grob: Basic Electronics; Schrader: Electronic Communications	Heathkit: Electronic Circuits, Student Workbook; Georgia: Electronics, Phase B
EC-04 Testing amplifiers for amplification		Wells: Audio Servicing: Theory and Practice	Wells: Audio Servicing: A Text-Lab Manual; Georgia: Electronics, Phase B
EC-05 Testing and repairing vacuum tube amplifiers			Prentice-Hall: Troubleshooting: A Self-Instructional Programmed Manual
EC-06 Testing and repairing transistor amplifiers		Lenk: Handbook of Practical Solid State Troubleshooting; Lenk: Handbook of Modern Solid State Amplifiers	Prentice-Hall: Electronic Troubleshooting: A Self-Instructional Programmed Manual

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CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
EC-07 Analyzing power supply circuits		Heathkit: Electronic Circuits; Grob: Basic Electronics	Heathkit: Electronic Circuits, Student Workbook; Georgia: Electronics, Phase B
EC-08 Testing and repairing power supplies		Grob: Basic Electronics	Prentice-Hall: Electronic Troubleshooting: A Self-Instructional Programmed Manual
EC-09 Calibrating power supply voltage		Lemons: Learn Electronics Through Troubleshooting	Prentice-Hall: Electronic Troubleshooting: A Self-Instructional Programmed Manual
EC-10 Analyzing the operation of oscillators		Heathkit: Electronic Circuits	Heathkit: Electronic Circuits, Student Workbook; Georgia: Electronics, Phase C
EC-11 Testing and repairing oscillators		Shrader: Electronic Communication; Horowitz and Hill: The Art of Electronics; Heathkit: Electronic Circuits	Heathkit: Electronic Circuits, Student Workbook; Georgia: Electronics, Phase C
EC-12 Testing and repairing counter circuits		Triebel: Integrated Digital Electronics; Tokheim: Digital Electronics; Heathkit: Digital Techniques	
EC-13 Analyzing pulse circuits		Heathkit: Electronic Circuits	Heathkit: Electronic Circuits, Student Workbook

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
EC-14 Testing and repairing nonsinusoidal amplifiers		Heathkit: Active Filters; Heathkit: IC Timers; Heathkit: Electronic Circuits; Horowitz and Hill: The Art of Electronics	Heathkit: Electronic Circuits, Student Workbook
EC-15 Analyzing amplitude modulator (AM) circuits		Heathkit: Electronic Circuits	Heathkit: Electronic Circuits, Student Workbook; Georgia: Electronics, Phase C
EC-16 Analyzing frequency modulator (FM) circuits		Heathkit: Electronic Circuits	Heathkit: Electronic Circuits, Student Workbook; Georgia: Electronics, Phase C
EC-17 Analyzing the operation of superheterodyne receivers		Georgia: Electronics, Phase C	
EC-18 Servicing tape recorders		Middleton: Tape Recorder Servicing Guide	
EC-19 Servicing record changers		Middleton: Record Changer Servicing Guide	
EC-20 Inspecting and repairing loudspeakers		Equipment service manuals; Parts catalogs	
EC-21 Inspecting and repairing microphones		Equipment service manuals; Parts catalogs	

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
EC-22 Laying out, taping up and drawing basic printed circuit boards		Raskhodoff: Electronic Drafting and Design; Lindsey: The Design and Drafting of Printed Circuit Boards	
EC-23 Constructing printed circuit (PC) boards	Georgia: Electronics Technology, Phase A, "Printed Circuits," (ST) 25-B	Lindsey: The Design and Drafting of Printed Circuit Boards	Georgia: Electronics, Phase B, Unit 25-B

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
TV-01 Analyzing the stages of a black and white TV receiver		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Georgia: Electronics, Phase C; Tinnell: Television Symptom Diagnosis
TV-02 Analyzing low voltage power supplies		Quasar: Motorola Quasar Projects; Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-03 Troubleshooting switch-mode secondary voltage supplies		Quasar: Motorola Quasar Projects; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-04 Troubleshooting synchronizing and deflection circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-05 Troubleshooting horizontal output circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-06 Troubleshooting sweep-generator circuits		McGraw-Hill: A Programmed Course in Basic Pulse Circuits; Heathkit: Electronic Circuits; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
TV-07 Troubleshooting high voltage supplies		Quasar, Motorola Quasar Projects; Heathkit: Electronic Circuits; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-08 Aligning the CRT and associated circuits		Quasar: Motorola Quasar Projects; Tinnell: Television Symptom Diagnosis	
TV-09 Troubleshooting vertical deflection circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-10 Adjusting the purity, focus and gray scale to produce a normal raster		Quasar: Motorola Quasar Projects; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-11 Analyzing the operation of video amplifiers		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	
TV-12 Troubleshooting defective video amplifiers		Quasar: Motorola Quasar Projects; Tinnell: Television Symptom Diagnosis	
TV-13 Analyzing video IF amplifiers		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
TV-14	Aligning RF and IF amplifiers		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-15	Analyzing the operation of sound IF and AM circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-16	Aligning sound IF and AM circuits		Quasar: Motorola Quasar Projects; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-17	Analyzing VHF and UHF tuner circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-18	Analyzing automatic fine tuning (AFT) and remote control circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-19	Analyzing automatic gain control (AGC) and noise cancelling circuits		Liff: Color and Black and White Television; Tinnell: Television Symptom Diagnosis	
TV-20	Analyzing color television signal reception and decoding		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	

CURRICULUM AREA: ELECTRONICS CLUSTER

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
TV-21 Testing picture tubes and associated circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Zbar: Basic Television: Theory and Servicing; Tinnell: Television Symptom Diagnosis
TV-22 Analyzing band-pass amplifiers, color killer circuits and automatic color control circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-23 Analyzing color sync circuits		Liff: Color and Black and White Television, Theory and and Servicing; Tinnell: Television Symptom Diagnosis	
TV-24 Analyzing color demodulator and output amplifier circuits		Liff: Color and Black and White Television, Theory and Servicing; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-25 Troubleshooting defective color tuning circuits		Quasar: Motorola Quasar Projects; Tinnell: Television Symptom Diagnosis	Tinnell: Television Symptom Diagnosis
TV-26 Analyzing and adjusting color convergence circuits		Quasar: Motorola Quasar Projects; Tinnell: Television Symptom Diagnosis	

TEXTBOOKS

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Bell, D.A., Electronic Devices and Circuits (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall, Inc., 1980.

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Georgia, Electronics, Phase C. Athens, GA: Vocational Education Materials Center.

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Middleton, Robert G., Tape Recorder Servicing Guide (2nd ed.). Indianapolis, IN: Howard W. Sams and Co.

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National Semi-Conductor Co., Linear Applications Handbook. Santa Clara, CA.

Newnes Technical Books, Electronic Diagrams; Simple Circuit Building Electronic Components; Printed Circuit Assembly; Practical Electronic Project Building; Project Planning and Building. Woburn, MA: Butterworth Publications.

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AUDIOVISUALS

Career Aids, Inc.	Filmstrips
Hobar Publications	Slide/tape, filmstrips
DCA Educational Products	Transparencies, 8mm filmstrip
Bergwall Production, Inc.	Filmstrips
Georgia Department of Education	Slide/tape
USAF, Aerospace Education Department	Video tapes
Sencore	Video tapes

STUDENT MANUALS

California State Department of Education, Sheet Metal Tools and Equipment Workbook.

Georgia, Microcomputer Concepts.

Georgia, Electronics Technology, Phase A. Athens, GA: Vocational Education Materials Center.

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Wilson, J. and Glass, D., Study Guide for Journeyman CET Examinations. Indianapolis: Bobbs-Merrill, 1976.

Audiovisuals

American Red Cross (Contact your local unit.)	Films
Association - Sterling Films 866 Third Avenue New York, NY 10022	Films
Audio Visual Service Kent State University Kent, OH 44242	Films
A.V.C. Media Library Audiovisual Center University of Iowa Iowa City, IA 52240	Audiovisuals
Bergwall Productions, Inc. 839 Stewart Avenue Garden City, NY 11530	Audiovisuals
Center for Occupational Curriculum Development P.O. Box 7218 The University of Texas at Austin Austin, TX 78712	Audiovisuals
Channel Master Motion Picture Division Ellenville, NY 12428	Films
DCA Educational Products 424 Valley Road Warrington, PA 18976	Audiovisuals
Delmar Publishers 50 Wolf Road Albany, NY 12205	Audiovisuals
Department of Audiovisual Extention General Extension Division University of Minnesota 2037 University Ave., S.E. Minneapolis, MN 55455	Audiovisuals
Department of Audiovisual Extension University of Minnesota 2037 University Ave., S.E. Minneapolis, MN 55455	Films

Digiac Division Digital Electronics Ames Court Plainview Long Island NY, 11803	Flip charts and transparency
Educational Film Library U.S. Naval Base Philadelphia, PA 19112	Films
Educators Progress Service, Inc. Randolph, WI 53956 "Educators Guide to Free Films"	Audiovisuals (free films)
Electronic Industries 43 West 61st St. New York, NY 10023	Films
Fabri-Tek Educational 1261 South Boyle Ave. Los Angeles, CA	Transparencies and wall charts
Federal Aviation Administration Film Library, AC-44.5 P.O. Box 25082 Oklahoma City, OK 73125	Films
Film Bureau National Association of Manufacturers 277 Park Avenue New York, NY 10017	Films
Georgia Power Film Library c/o Modern Talking Picture Service 4705-F Bakers Ferry Road, SW Atlanta, GA 30336 (404) 696-2025	Films
Instructional Materials Laboratory The Ohio State University Columbus, OH 43210	Audiovisuals
Instructional Materials Laboratory 10 Industrial Education Bldg. University of Missouri-Columbia Columbia, MO 65211	Audiovisuals
Industrial Press, Inc. 200 Madison Avenue New York, NY 10057 (212) 889-6330	Audiovisuals

Modern Talking Pictures Service c/o Film Programs, Inc. 2238 Euclid Ave. Cleveland, OH 44115	Films
3M Brand Visual Products Box 3100 St. Paul, MN 55101	Transparency
NASA Lewis Research Center Office of Educational Services 2100 Brookpark Road Cleveland, OH 44135	Films
National Society for Prevention of Blindness Public Information Department 79 Madison Avenue New York, NY 10016	Films
Popular Science Filmstrip of the Month 355 Lexington Avenue New York, NY 10017	Filmstrips
Prentice-Hall Media ServCode VD 3 150 White Plains Road Tarrytown, NY 10591	Filmstrips
Singer Society for Visual Education 1345 Diversey Parkway Chicago, IL 60614	Filmstrips and recordings
Serina Press 70 Kennedy Street Alexandria, VA 22305	Audiovisuals (free films)
Superior Electric Co. Media Manager 303 Middle St. Bristol, CN 06010	Films
Tectronics, Inc. Film Library Delivery Station 76-580 P.O. Box 500 Beaverton, OR 97005	Films
U.S. Army Visual Support Center Annville, PA 17003	Films

United Transparencies, Inc. P.O. Box 688 Binghampton, NY 13902	Transparency
Visual Aids Service Division of University Extension University of Illinois Champaign, IL 61820	Audiovisuals
Visual Aids Service Division of University Extension University of Illinois Champaign, IL 618200	Films
Vocational Instructional Services Texas A & M University College Station, TX 77843	Audiovisuals
Vocational-Technical Curriculum Laboratory Rutgers-The State University Bldg. 4103-Kilmer Campus New Brunswick, NJ 08903	Audiovisuals
Wisconsin Vocational Studies Center University of Wisconsin-Madison 964 Educational Services Bldg. 1025 W. Johnson Street Madison, WI 53706	Audiovisuals

RESOURCE ADDRESSES

AAVIM
120 Engineering Center
Athens, GA 30602

American Tech
5608 Stony Island Avenue
Chicago, IL 60637

Bennett Publishing Company
809 W. Detweiller Drive
Department E-81
Peoria, IL 61615

Bergwall Productions, Inc.
839 Stewart Avenue
Garden City, NY 11530

Bishop Graphics, Inc.
Westlake Village, CA 94107

Bobbs-Merrill Educational
Publishing
Department No. 627
4300 West 62nd Street
P.O. Box 7080
Indianapolis, IN 46206

Buck Engineering Co.
Farmingdale, NJ 07727

CTI Education Products
Mt. Pleasant, SC 29464

California State Department
of Education
Bureau of Industrial
Education
721 Capitol Mall
Sacramento, CA 95814

Career Aids, Inc.
8950 Lurline Avenue
Department T. 76
Chatsworth, CA 91311

Charles A. Bennett Company,
Inc.
809 Detweiler Drive
Peoria, IL 61614

Delmar Publications
50 Wolf Road
Albany, NY 12205

Georgia Department of Education
Vocational Curriculum Center
3952 Shirley Drive
Atlanta, GA 30336

Georgia Office of Vocational
Education
Georgia Department of Education
Atlanta, GA 30334

Goodheart-Willcox Company
123 W. Taft Drive
South Holland, IL 60473

Gregg/McGraw-Hill
P.O. Box 996
Norcross, GA 30091

Heath Company
Benton Harbor, MI 49022

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112

McKnight Publishing Company
Box 2854
Bloomington, IL 61707

Mid-America Vocational
Curriculum Consortium (MAVCC)
1515 West Sixth Avenue
Stillwater, OK 74074

National Semi-Conductor Co.
2900 Semi-Conductor Drive
Santa Clara, CA 95051

National Training Aids, Inc.
Manual Division "M"
P.O. Box 565
Norcross, GA 30091

Newnes Technical Books
Butterworth Publishing, Inc.
19 Cummings Park
Woburn, MA 01801

Prentice-Hall Media
ServCode VD3
150 White Plains Road
Tarrytown, NY 10591

Quasar Electronics Corp.
Technical Training Systems
Atlanta, GA 30303

Singer Career Systems
80 Commerce Drive
Rochester, NY 14623

(The) Superintendent of Documents
United States Government Printing Office
Washington, DC 20402

Technical Publishing Co.
Barrington, IL 60010

Training Technology, Inc.
(See Vocational Curriculum Center)

Vocational Education Materials Center
Green Street
The University of Georgia
Athens, GA 30602

APPENDIX B

Special Needs

WORKING WITH SPECIAL NEEDS STUDENTS*

Introduction

Special needs population students are those who are designated as handicapped or disadvantaged. The 1976 vocational education amendments define handicapped individuals as:

> Persons who are mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or persons with other specific disabilities, who by reason thereof require special education and related services and who cannot succeed in the regular vocational education programs.

In those same amendments disadvantaged persons are defined as:

> Persons (other than handicapped persons) who have academic or economic disadvantages and who require special services, assistance or programs in order to enable them to succeed in vocational education programs.

Federal legislation requires that these special needs population students be given an opportunity to function in regular vocational education programs (essentially, this is what is meant by the term mainstreaming). This section provides information on how such students are identified and how they can be mainstreamed into regular vocational education environments.

Figure One presents a conceptual model depicting various activities of the process in identifying and mainstreaming special needs students in vocational education. These activities

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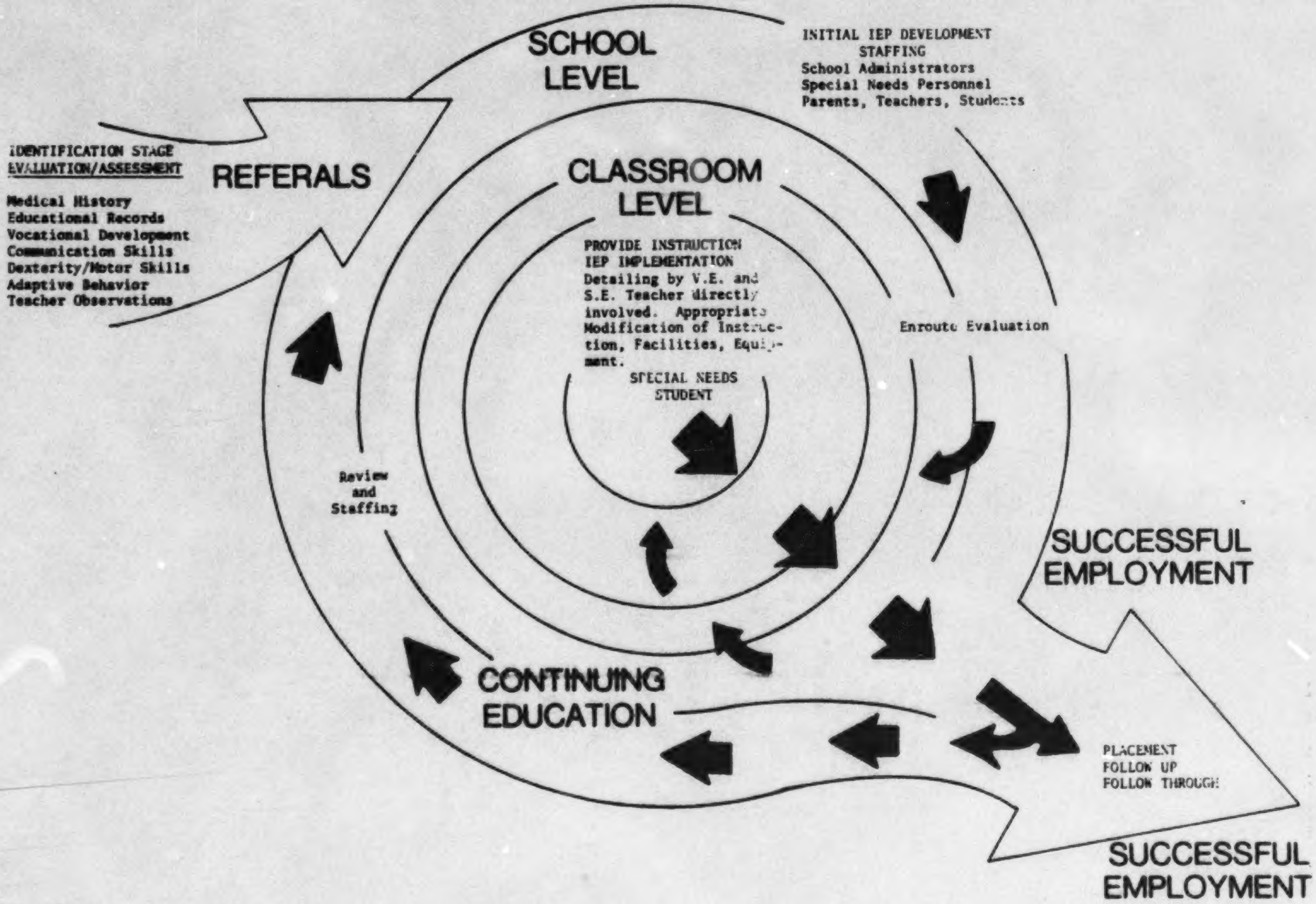
*The project director wishes to thank Mrs. Ann Lary, State Department of Eduction staff and Mrs. Rhonda Packer, VEMC staff, for their careful review of this section and for their suggestions that improved the overall value of this paper. Appreciation is also extended to Ray Butler for his patient work in reviewing and sorting available resources.

THE CONCEPT OF MAINSTREAMING


SCHOOL LEVEL
INITIAL IEP DEVELOPMENT
STAFFING
School Administrators
Special Needs Personnel
Parents, Teachers, Students
IDENTIFICATION STAGE
EVALUATION/ASSESSMENT
Medical History
Educational Records
Vocational Development
Communication Skills
Dexterity/Motor Skills
Adaptive Behavior
Teacher Observations
REFERALS
CLASSROOM LEVEL
PROVIDE INSTRUCTION
IEP IMPLEMENTATION
SPECIAL NEEDS STUDENT
Enroute Evaluation
Review and Staffing
SUCCESSFUL EMPLOYMENT
CONTINUING EDUCATION
PLACEMENT
FOLLOW UP
FOLLOW THROUGH
SUCCESSFUL EMPLOYMENT

Detailing by V.E. and S.E. Teacher directly involved. Appropriate Modification of Instruction, Facilities, Equipment.

are conducted at three levels: the system level, the school level and the classroom level. All three levels must work together if implementation of the process is to be effective.

Identification of the Special Needs Student

Through a variety of pre-testing procedures, special needs students are identified and their potentials are evaluated at the system level. This evaluation process consists of collecting and assessing the following data for each student:

- Medical History
- Educational Records
- Vocational Development
- Communication Skills
- Dexterity/Motor Skills
- Adaptive Behavior
- Teacher Observations

When this procedure has been completed, the system personnel refers the student to the appropriate school level personnel. As a part of the referral and school intake process an Individualized Educational Plan should be initiated.

> The Individualized Educational Plan (IEP) is exactly what its name implies--a plan for the education of a specific individual. The base content of the IEP is outlines in Public Law 94-142. According to that outline, the IEP must include at least the following information: (a) student's present level of functioning, (b) his/her long range instructional objectives, (c) his/her short-range instructional objectives and finally, (d) some criteria to determine that those objectives have been achieved.

Development of the Individual Education Plan

It would be very difficult to anticipate the exact kind or type of special needs students one might find in an Electronics Cluster program at any one time. The terms disadvantaged and handicapped are really "catch-all" terms that indicate a wide assortment of problems that might occur in a student representing one of these populations. In addition to the lack of a specific definition and the fact that the typical vocational instructor has had very little preparation in working with these students, it becomes clear that you will need a basic plan to use in meeting their occupational preparation needs. The following steps can serve as your basic planning procedure for mainstreaming a special needs population student into your curriculum.

The first step occurs after you have been notified that a special needs student can profit from being in your vocational program. When you have received that notification, you should contact your vocational supervisor and ask for a detailed report of the student's assessed status. Note the word assessed; it is critical. Through a formal assessment status, appropriate school personnel should have identified the student's strengths and weaknesses as well as the specific handicapping conditions. After you have received the assessment information and understand it you are ready for Step Two.

Step Two, developing (or completing) the vocational aspects of the Individual Education Plan-IEP, is usually performed for handicapped students only; however, it has just as much merit for the disadvantaged. The IEP is a very useful tool. It should be considered the description of what you expect that student to be able to do when he or she completes your course and how you will provide the learning experiences to assure that those expected outcomes will be achieved. Be sure that you keep this IEP in a convenient place and use it.

The IEP is usually developed through group activities called staffings. Staffings* may be held as often as needed and can be used to modify the IEP as the student moves through the program. When a student is about to be mainstreamed into your curriculum, you must become involved in the staffing sessions that will develop the vocational aspects of the IEP. IT IS YOUR RIGHT AND YOUR DUTY, therefore, your being present during the staffings is imperative. The special education personnel can present the student's interest, strengths and limitations. However, only you, the vocational instructor, can relate these to your program. This means that the final statement of the job (DOT) and the task level (short term) objectives are primarily defined by you the vocational instructor.

In Step Three the IEP will first be used to suggest how the curriculum and/or the facilities can be modified to accommodate the special needs population student. Modifying the curriculum means that in most cased special adjustments will have to be made in the student materials and that special instructional strategies will need to be developed. When you say modify the curriculum you are not suggesting that the content be "watered down" - you are proposing alternate ways to teach the proper/required content. REMEMBER! ALL VOCATIONAL EDUCATION PROGRAMS ARE BASED ON REAL JOBS THAT HAVE THEIR OWN TASKS AND STANDARDS. AS FAR AS YOU ARE CONCERNED, YOU HAVE NO

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*At least one staffing per student is required annually. This will ensure that the student is progressing toward prescribed goals at an appropriate rate.

POWER TO CHANGE THESE. YOU ALSO CANNOT SUCCESSFULLY CREATE A WHOLE NEW JOB.

Modification of facilities and equipment is a concern when working with the phyically handicapped. Be reminded that by law your school building must already meet requirements of accessibility to all handicapped persons--especially those who are blind or are confined to wheelchairs. Your chief concern is to be sure that your classroom and laboratory will allow the handicapped students to be comfortable and above all to learn. You will also need to make certain modifications that will enable the handicapped students to properly and safely use the "tools and equipment of the trade". It is foolish to think that you would have a ready answer for all or any particular one of these physical handicaps--call on the experts. Vocational rehabilitation counselors and other staff have been concentrating on these problems for many years. They should be able to offer a number of positive suggestions. A combination of VR experience and instructor creativity can and has produced outstanding results.

As we think about curriculum modification it would help to review some general learning needs of these populations.

> The educationally mentally retarded will constitute a major population now entering vocational education. The key concept to remember in modifying the curriculum for this population is that they require much more detail in order to learn and they require a great deal more practice time. All curriculum modifications for these groups should be made by detailing each task or objective into its smallest parts and by providing for more and more practice.
>
> The hearing and visually impaired can be accommodated by common sense and the use of supporting resource personnel. Neither of these groups reads well or learns from reading

as a primary mode. This should be accounted for in modifying the curriculum, i.e., larger print, brail and recordings for the blind and captions on visual materials, seating arrangements, use of notes from a classmate, lower reading level textbooks, oral testing, and total communications for the deaf.

The orthopedically handicapped usually require attention to facilities and equipment. Beyond that, their learning needs are as varied as those of the normal population. Remember, some of these individuals will actually be highly gifted in their chosen field. Their major needs will be psychological and coping with the school environment.

The disadvantaged are physically and mentally capable of learning, but their background has not allowed them to fully develop the discipline and cognitive skills (i.e., vocabulary, math, etc.) required to master occupational preparation courses. They have also developed an anti-school attitude that complicate many efforts to modify the curriculum for them. Usually their success in the vocational program is contingent on either a good pre-vocational program or a supporting academic program.

Step Four requires that instructional strategies be selected. These strategies may be many and should be varied. They should reflect the best learning technique for a given student and his or her chosen occupation. Some examples of instructional strategies are discussed below.

Teacher demonstration: Simply show the student how the job is to be done in clear distinct steps.

Peer demonstration: This technique allows the instructor to use one of the advanced students to demonstrate a particular task in a step by step fashion. It is a flexible system. For example, you can use the peer demonstration to show each task step while you explain them to the students. When working with the mentally retarded, you will never have enough time to demonstrate a task as often as they may need to see it. In such situations, the well prepared advanced student can perform and explain the same demonstration several times.

Shadowing: Shadowing can be used in conjunction with demonstrations. By shadowing, the student is allowed to do exactly what the demonstrator does. This allows the student to learn in a see and do fashion. The student may shadow the instructor, an advanced peer or in some instances the worker on the job.

Job site visits: Job site visits offer the student an opportunity to see the work being done in its natural location. Students can develop a worker identify and a realistic view of how the tools, equipment and materials are brought together to produce the product.

Work group or team: By being a part of a work team, the student can learn the various roles in an occupation as having the opportunity to practice specific sets of skills under the tutelage of peers.

Individualized instruction: Appropriately prepared or adjusted individualized instruction is a big help in managing a class that contains a mixture of special needs population students and "norm group" students. Individualized instruction, no matter what the source, will require much developmental input from the instructor. In most all cases, however, the results are worth the effort.

Media: Many of the special needs populations require mediated instruction (i.e., hearing and visually impaired), however, the use of appropriate media enhances learning for all students. Media can range from a line drawing in an instructional module, to a video tape, to posters and charts. It can be instructor made or commercial. All that matters is that it exactly links to the objective.

Project Method: The value in using projects with special needs population students is that they help them mentally and physically unify all the parts into a uniform whole. Because of the detail required for them to learn, they need learning activities that relate all of the parts to the whole. The development of a product through an assigned project is an ideal integrating experience.

Simulations: Simulations meet a variety of instructional needs. One of the more important with special needs population students is providing the opportunity to develop proper safety concepts before actually working with the "live" equipment that could be dangerous to a careless student.

Role playing: Role playing is a part of several other instructional strategies. On its own, it is a very good procedure for developing the attitudes and values required of a successful worker-i.e., a sense of responsibility, the ability to take orders and follow directions, interpersonal skills and so on. It is a way to concentrate on developing good work habits and positive attitudes.

Peer instruction: Like peer demonstrations, peer instruction is able to multiply the instructor's available time. This allows individual students with specific needs to have more assistance. Peer instruction has values beyond expanding time; it is an excellent approach to learning. In almost every situation, both the peer teacher and the peer student profit from the exchange. In operation peer instruction is simply a matter of preparing and allowing one of the advanced students to teach small groups certain segments of a course.

Team teaching: As we have already noted, some special needs populations require a combination of vocational and special education presented in harmony. A team approach is the only way to meet that need. For team teaching to be effective, clarification of student needs (as defined by the IEP) and careful planning will be required.

Peer apprenticeships: The peer apprenticeship is an ideal way to induct the new special needs population student into the curriculum. By serving as the apprentice to an advanced student, the special needs population student can become climatized to the laboratory/shop and can begin to learn the tools, equipment and materials of the program. The shadow technique can also be added to increase hands-on learning.

Assessment and feedback: Student learning can be improved by frequently assessing students' skills and feeding back their strengths and weaknesses. Through a process of positive feedback, the student can be moved gradually from where he or she is to the level of skill required.

These instructional strategies can be used independently or in various combinations. This brief list is meant only to provide you with some suggestions, there are no doubt many other techniques that could be used. The creative instructor will be constantly innovating to meet the needs of particular students.

Implementing the IEP

Step Five is a matter of putting the vocational aspects of the IEP into operation. The activitivation of the IEP initiates the student into the vocational education program and allows him or her to progresses at his or her optium rate through the modified curriculum. There should be frequent assessment activities that indicate where the student is relative to the IEP objectives. If problems are detected, a staffing should be conducted to re-evaluate the IEP and continue the process in a fashion that is most beneficial to the student.

Step Six will take the student to his or her next logical step of either totally exiting the system or recycling into a continuing education mode. In most cases, the student will do some of both--getting a job and periodically accessing the continuing education component of the educational system to refine existing skills or to broaden his or her capacity.

The ultimate goal of all this effort is not employment-rather it is "successful employment". Successful employment implies that not only is the student placed in a job, but that the student is able to sustain himself or herself in a working environment over an extended period of time.

Evaluation

Evaluation of the student's program is a critical step. Through that process we not only help the current student, but we are able to gather information that will improve our potential to help students with similar difficulties in the future. A well rounded evaluation system should consist of the following activities:

- En-route evaluation (formative) to monitor the student's progress through the program.
- Summative evaluation upon completion of the program to determine job readiness.
- Follow-up after placement to determine if the student is successful on the job.

-Follow-through activities designed to identify any further training needed, which may be indicated by the follow-up procedure.

RESOURCES

In recent years, mainstreaming of special needs population students has been an area of great concern to vocational educators. The overall result of that concern is an abundance of well developed resource materials and a variety of personnel with special skills in working with these groups. In the space allowed by this curriculum guide, it would be impossible to present an adequate set of methods and procedures for solving the problems of students with special needs, but if the vocational education administrator and instructor will judiciously use the human and material resources listed here, much of the in-depth information required for the special and unique cases that will occur can be compiled from these sources.

Support Personnel or Systems

As was noted earlier, you the vocational instructor, simply do not have sufficient skills to work with special needs population students alone. There are too many different student problems to ever allow an instructor to deal with them all on a "come as you are" basis. For that reason, you must make yourself aware of the variety of support systems and personnel that are available to you and to the students. A few of these are listed here. These specialists can lead you to others on an as needed basis.

County Health Department - Many of your special needs population students will need some medical and dental assistance. The county health facility is an excellent referral source for these problems.

Special Education - Through local boards of education there are a variety of special education personnel available locally, regionally and from the State Department of Education. The vocational education administrator can obtain assistance from these specialists through the local superintendent's office.

Project SERVE - Project SERVE is a statewide effort to acquire materials and to cultivate expertise in providing vocational education to disadvantaged. Project Serve can be contacted by the area vocational-technical director or the vocational supervisor.

Vocational Rehabilitation - Vocational rehabilitation is a highly developed organization whose major focus is all dimensions (such as: diagnosing, training, job placement and counseling) of the handicapped population. Within that network is a vast pool of expertise. You can contact it through the area vocational rehabilitation counselor who calls on your school or vocational rehabilitation through a designated school official such as the vocational supervisor or school counselor.

Related Vocational Instruction - The RVI program is designed to provide special education and support instruction to secondary vocational education programs. Although an RVI instructor is not available to every school, they are a valuable all around resource in the schools where they now work.

Coordinated Vocational and Academic Education - CVAE is a prevocational program designed to assist disadvantaged students in developing the basic skills required to succeed in vocational education and in entering an appropriate program. The CVAE coordinator and the interlocking team of teachers are an excellent resource to the vocational instructor who is working with the disadvantaged in regular vocational eduction programs.

All of the resources and resource personnel listed here are a part of the team. The best results can be obtained by using as many of these people and their support systems as possible from the beginning. In some situations, you will miss a resource in the beginning or the student's needs change. When that occurs do not hesitate to call on the appropriate experts for additional help. As a matter of fact, the rule of thumb that has always been used in the "helping professions" is to go as far as you can, then refer. Do not hesitate to call for help. Most of these service groups are funded to support "your" student. If you do not use them, they fail in their mission and you fail in yours.

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APPENDIX C

Definition of Terms

DEFINITION OF TERMS

1. A/Vs-Audiovisuals - May refer to any picture and/or sound media. (ie. slides, tapes, filmstrips, 16 mm films, etc.)

2. Checkpoint - A student-instructor interface point wherein the instructor may give the student a test, perform a demonstration, or simply provide the student with additional needed information or instructions. Also a checkpoint may be used for motivational purposes.

3. Competency - The ability (knowledge, skills and attitudes) to perform all of a group or cluster of related tasks required to complete a designated activity according to occupational standards. In the educational setting, the statement of a competency includes expected student outcomes in terms of knowledge, skills and attitudes required to complete a designated activity as defined by incumbent workers according to the standards of the work place.

4. Course - A grouping of tasks and competencies which have a common knowledge base or are within a given domain.

5. Criterion-Referenced Measure - An exercise based upon a performance objective, the accomplishment of which measures attainment of that objective.

6. Criterion-Referenced Test - A test designed to measure student competencies based on job or industrial standards.

7. Curriculum Guide - A document containing the objectives, content, organization and structure of an instructional program. It is designed for use by administrators, instructional supervisors and teachers.

8. D.O.T. - Abbreviation for Dictionary of Occupational Titles. Document provides nine digit codes identifying each occupation.

9. Duty - One of the distinct major activities involved in the work performed. A Composition of related tasks.

10. Exit Point - A pre-determined point within an instructional program in which a student may exit with the essential competencies for a specific job. Usually defined in terms of D.O.T. codes and/or O.E. codes.

11. "Hands-On" - Statement implying the student is physically involved in a learning activity.

12. Individualized Instruction (I.I.) - A system of instruction allowing a student to progress at his/her fastest rate.

13. Job - A specific area of specialization within an occupational field consisting of several closely related duties for which a person would expect to receive remuneration. Should be identified by DOT code.

14. Job Sheet - (Or Operations Sheet) - A project of a performance nature. Generally performed by the student in a lab or shop type environment or in a specialized work area.

15. Live Work - Generally refers to items brought into the course area for repair or adjustment. Examples of live work might be automobiles, radios and TV's, air-conditioners, etc. Another form of live work would be patrons visiting the cosmetology department to receive permanents or other services.

16. Master Copies - Original copies of slides, tapes or written materials set aside for the purpose of duplication.

17. Occupational Cluster - A group of occupations sharing a common core of competencies. Georgia's comprehensive high school vocational program is organized around this concept.

18. Occupational Inventory - A listing of tasks to be performed in a particular occupational area, grouped under duty classifications.

19. O.E. - Refers to the U.S. Office of Education. O.E. codes are a classification system (taxonomy) for occupational education programs.

20. Open Entry - Term meaning that a student may enter the program at any time and does not have to wait for quarter or semester breaks.

21. Open Exit - Term meaning that a student may leave a program any time he/she completes occupational objectives.

22. Performance Guide - A series of steps arranged in a sequence which when completed may result in the performance of a task. Also called teaching steps.

23. Performance Objective - A statement in precise, measurable terms of a particular behavior to be exhibited by a learner underspecified conditions. It possesses each of the elements or characteristics specified below:

    a. Condition - The testing situation confronting the learner is clearly specified. This includes equipment provided or withheld, environmental constraints such as temperature, space, etc.

b. Performance - The specific behavior expected of the learner is stated.

c. Standard - The degree of acceptable performance is specified.

24. Performance Test - A test entailing not only the ability to answer questions, but measuring the student ability to operate, manipulate or perform a given task.

25. Program - An organized sequence of courses leading to an occupational objective. A program may contain one or more student exit points as defined by D.O.T. codes.

26. Program Objective - The outcome of a prescribed program of instruction. Usually expressed in terms of the occupation or job for which training is designed. D.O.T. codes are frequently used to identify program objectives or student exit points.

27. Self-Paced - Refers to a student moving through the prescribed training program at the fastest pace at which he/she can meaningfully learn.

28. Sequencing - Putting any set or series of learning activities or tasks into proper order or sequence. Normally arranged from simple to complex within groupings or blocks.

29. Software - Written or printed materials, slides, filmstrips, tapes, etc.

30. Student Manual - A document designed for use by students in a specific instructional program. It contains unit sheets, references, operational procedures, job sheets, etc.

31. Task - The smallest division of work in which a measurable output occurs. A logical and necessary step in the performance of a duty.

32. Task List - A listing of tasks performed by incumbent workers within a domain of interest. An example is a listing of all tasks performed by an automotive mechanic or by a worker in ornamental horticulture.

33. Unit - One "module" training material that generally covers one learning task and programmed on one unit sheet. May cover more than one lesson.

34. Unit Guide - A curriculum guide sheet that lists a task and objective with the instructional activities,instructional materials, evaluation and approximate time required for a student to successfully complete the task.

35. V'TECS Catalog - A comprehensive collection of performance objectives, performance guides, criterion-referenced measures and related data. Organized by a job structure or career ladder within a domain of interest.

Federal law prohibits discrimination on the basis of race, color or national origin (Title VI of the Civil Rights Act of 1964); sex (Title IX of the Educational Amendments of 1972 and Title II of the Vocational Education Amendments of 1976); or handicap (Section 504 of the Rehabilitation Act of 1973) in educational programs or activities receiving federal financial assistance.

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Title VI - Peyton Williams Jr., Associate Superintendent of State Schools and Special Services
Title IX - Evelyn Rowe and Myra Tolbert, Coordinators
Section 504 - Jane Lee, Coordinator of Special Education

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